KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 3, 1884.

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GAMBLING, SHOW-PRAYING, AND LECTURING AT SEA.

By Richard A. Proctor.

MR. THOMAS HUGHES, Q.C., the author of "Tom Brown's School days at Rugby," arrived in New York on August 31, on the *City of Rome, en route* for Rugby, Tenn. He was interviewed by a reporter of the *New York Herald*, who reports that Mr. Hughes was fired with enthusiasm, not so much in relation to the new Rugby and its proposed school, as about a disturbance which had occurred on the steamer coming over.

The following is the report of the interview :—

"There are on the deck of the steamer," Mr. Hughes explained, "two rooms—one a smoking-room, and one a reading-room. The reading-room is supposed to be for the use of the ladies as well as the gentlemen. Monday, the third day out, they turned the room into a card-room and smoking-room, going on with cards, draughts, &c., all day. Well, I went off to the smoking-room, and found that there had been a baccarat bank started there. A man from Australia—a perfectly good, honest fellow he was, but he made his living that way—had started the game with three other men, all middle-aged. The bank was a perfectly square one and the play was entirely honest, so far as I know and believe.

"This was kept up all day, and up to the time of putting out the lights and going to bed, and every day after that, from eleven o'clock in the morning till bedtime, this baccarat bank was kept going; and there was much of the time a row of players five or six deep around the game. Many of these were mere boys, lads of twenty or less, who were allowed to punt their shillings or dollars, or more. The stake was sometimes up to £5, I believe.

"Now, I do not object to the baccarat going on, but what I did object to was its being carried on openly, and boys being allowed to join in the game. And I objected, as many others did, to the reading-room being made inaccessible to the ladies. So one of the passengers, a friend of mine, drew up a memorial, and I led the signatures with my own. It was signed by a large number of the passengers.

"This paper was lying on the saloon table, and the passengers were signing it in great numbers, when I was told that a fellow named Lord was up on deck talking about it and telling all sorts of lies about what we were doing. I went right up and spoke to him. I asked him if he had read the memorial, and he admitted that he had not. Then there was some sharp talk, and a friend of mine, a young American gentleman, struck one of the other side. Of course, we stopped them at once, but there were some sharp discussions afterward and a great deal of bad feeling.

"Since we landed," he continued, "we have presented the memorial to the agents here, and they say they do not propose to do anything about it, so I want the press to take it up. It is going to do a great deal of hurt if our youth are to be exposed to this temptation. A great proportion of the travellers on these steamers are mere boys, and I do not think it right or proper that they should be admitted to any game of this kind. Baccarat is not allowed at our clubs in London, and it seems a pity that it should be played openly on the steamers."

"Capt. R. D. Monroe, the commander of the ship," adds the *New York Herald*, "said that many persons at sea like to pass the time by playing cards for money. The amount of gambling on the *City of Rome's* last trip was not serious. The trouble, he thought, was caused by a young man of twenty losing more money than was convenient, but the circumstances were not such as would justify Capt. Monroe's interference. He thought that his refusal to permit prayer-meetings to be held in the saloon had something to do with the memorial. He did not hear of the paper till the vessel reached quarantine."

I made my own last journey to America in the *City of Rome*, and although I made certain betting transactions which took place on that ship the theme of a short article on the inaneness of the method for passing time to which Capt. Monroe refers, I must say the gambling on board the *City of Rome* was not greater than usual. In the saloon, indeed, there was less gambling than usual—all the whist, for instance, being for "love," whereas usually a good deal of high play takes place in a quiet way. (I remember a case, nine years ago, in which a young New Yorker of moderate means, playing with three merchants who made the points a sovereign a-piece with a five-pound note on the rubber, lost a much larger sum in an evening than he could probably earn in a month.) I heard of much poker being played in the smoking and reading-rooms; but as I was never in the former and only in the latter to get and return books for my family, I can only speak from hearsay. I take it, poker is as busy a gambling game as baccarat; only the latter seems regarded as suitable for clubs, till forbidden by law, while poker seems an appropriate game for cowboys *et id genus omne*.

I must confess I rather pity the captains of ocean steamers, when the rival claims of gambling and show-piety are brought before them. *Only*, if Capt. Monroe did right, as he unquestionably did, in not allowing the use of the saloon for prayer-meetings, he would have done right in forbidding the use of the smoking-room for a baccarat bank, supposing always he was asked to do so. The saloon, smoking-room, and reading-room of an ocean steamer are for the use of the passengers as a body, not for any particular set. If a large majority of the passengers agree to the use of any of these rooms for a special purpose—the captain and purser assenting—it is fitting for the minority to yield. For instance, there is always a certain minority opposed to the use of the saloon for entertainments, dramatic, musical, and otherwise; but they generally put up readily enough with what is to them an annoyance so long as it lasts. As regards prayer-meetings (on week-days), they are never

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supported by more than a small minority, usually consisting of the steadiest members of the community—excepting only the gambling set. It has always seemed to me as if they started their show-piety just about the time when every fellow-passenger had thoroughly recognised their position as the gloomiest and worst-tempered members of the company. They very seldom find a captain willing to listen to them. The gambling set usually get what they want, by not asking too much. Here and there in the saloon you see a table round which three or four low-browed fellows—some rapacious-looking, others looking more or less idiotic—sit playing for "chips," which represent in reality tolerably large sums of money. In the smoking-room you see more of this crew. There, also, wagering on the ship's run, on the number of the pilot, his complexion, the leg he first puts on board, and other such absurdities, may be watched by those who take interest in noting the lower instincts of humanity. You generally hear towards the close of the journey that a certain number of the more foolish have lost "more money than is convenient," as Capt. Monroe pleasantly puts it. But pity is wasted on these foolish folk. "If wilful will to water wilful must wet,"—that is all that can be said.

When, however, it comes to setting up a baccarat bank, or any other systematic gambling trap, in smoking-room or reading-room, the case assumes a different complexion. The majority of the passengers ought not, however, to trouble the captain or purser in such a case, unless either has given special permission to the swindlers to start their nefarious business. (I reject utterly Mr. Hughes's assertion or admission that the men were honest who started the baccarat bank, or that their system was fair and square; there is no such thing as honest gambling.) They should have claimed their own rights. A sufficient number of ladies and gentlemen should have occupied the reading-room and its neighbourhood; a sufficient number of gentlemen should have broken up the baccarat bank in the smoking-room; and both sets of well-meaning members of the community temporarily brought together should have expressed before the wrong-doers—as occasion arose—their sense not only of their own rights, but of the blackguardism of the attempt to introduce their evil ways into a company of respectable persons. Writing memorials can be of little use in such cases. But a large number of those who will gamble among gamblers are ashamed to go on gambling in the presence of ladies and gentlemen, and in face of their openly expressed contempt for such practices.

A minority even can effectively maintain their rights when these are invaded. I remember hearing of a case on board the *Arawata*, a New Zealand steamship, where an inexperienced lecturer who—strange to say, actually *wanted* to lecture during a sea journey!—was beaten by a small party of passengers who, finding that no one really desired his discourse, continued talking and laughing in his neighbourhood so that none could hear him. A lecture on board ship is a nuisance any way—at any rate to an unfortunate being who is asked to give one. This happened to me in five out of my first six ocean journeys, despite entreaties to be let off. It shows what straits a ship's company may be reduced to for amusement, when nine-tenths of the passengers ask, as a favour, for what certainly only one-tenth of the general community on land would desire. It puts a lecturer in rather an uncomfortable position. If he accedes to the request, a few who object are sure to suppose he has put himself in the way of the work—preposterous though such an idea is in the case of any lecturer having an established position in his profession. If he declines, many consider it must be from churlishness, preposterous though that idea should be, also. On the whole, however, I have had no reason to complain; and I believe the few lectures I have given on board ship have been found unexpectedly free from the dry-as-dust quality supposed to be proper to astronomy. Yet a very small minority would always have sufficed to stop any lecture I had been announced to deliver. If a fourth or a fifth, even, of the company object to the use of any of the ship's public rooms for such a purpose they have a right to maintain their objection. I have never known, however, a case where a minority has acted in such a case otherwise than by keeping away. I have known a case where a majority acted very decisively that way. Indeed, where any one on board ship obtrudes himself either by undertaking to pray for less devout passengers, or by offering gambling facilities, or by proffering a discourse or a lecture, he can expect (and deserves) no other treatment.

But in all such cases, the passengers should act for themselves. Neither purser nor captain should be unnecessarily troubled. Each has enough to attend to without being worried about matters which the right-minded members of the community can settle by their own action. The case illustrates aptly Mr. Thomas Foster's discussion of "The Morality of Happiness." A due regard for the rights of self should be corrected by a just appreciation of the rights of others, and *vice versâ*. The unduly complaisant are almost as mischievous by neglecting to claim just rights, as are the unduly egotistic by claiming what they are not entitled to. The latter try to injure by wronging the rest; but the former may do just as much harm by failing to take their proper part in the work of resisting such wrong-doing.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THERE are many cases in which it is not wise to trust to the old adage that seeing is believing, and the microscopist should make himself acquainted with the sources of fallacy. The difficulties of interpretation are most troublesome where high powers, large angled glasses and condensers of the same nature, are employed. Every student of minute forms is delighted, for example, with diatoms, and not a few microscopists go mad over them, look at nothing else, and deserve the nickname of diatom-maniacs. But while we laugh at them, we should confess that they have rendered an important service in continually demanding more and more approach to perfection in the construction of objectives and means of illumination. For thirty years and more they have studied their pet objects, and again and again some enthusiast has imagined he had quite settled their structure, but the battle still rages, and no one can see when it is likely to end. There are many points to be decided. First, are certain round markings elevations or depressions? Are they really round or hexagonal? How many distinct or distinguishable layers make up the siliceous skeleton of the little plants or animals, or borderland creatures, as the inquirer may prefer to call them? Again, are certain aperture-looking dots real holes or sham ones? The student of natural history in other departments, and of physiology and minute anatomy, may care little for diatoms, or the disputes of the diatom-maniacs, but he meets with the same sort of difficulties that bewilder them, and often cannot, for the life of him, tell when seeing should be believing.

For a low-power experiment introducing one of the difficulties, take a three-inch objective and a lady's silver thimble. There is no doubt concerning the thimble's struc-

ture, its depressions and borders, separating one from another, are as plain as the cells of a honeycomb, but if viewed at night, and strongly illuminated from one side, it is very likely to look as if every depression was an elevation. Sometimes if this effect is produced with one-eyed vision, a right view can be obtained by a binocular one, but sometimes not. There are many cases in which depressions look like elevations. Examining the moon through a telescope leads some folks, not infrequently, to see all the crater hollows as projecting mounds, and when the eye has once been deceived, the false view is apt to be excessively troublesome. Nasmyth's admirable moon slides for the lantern frequently puzzle observers, and their difficulty in seeing the hollows lower than their elevated surroundings is increased if slides with shadows to the right succeed others with shadows to the left. Hollow casts of gems in plaster of Paris, or sulphur, can easily be made to look like cameos, either by help of a magnifying glass or a simple hole, a quarter of an inch in diameter, cut through a blackened card. The experimenter with the thimble can usually arrange the light, &c., as to show the true structure, but if the eye has once caught a wrong picture, it may refuse to have it corrected. Besides looking at the thimble itself, impressions in black and red sealing-wax should be examined.

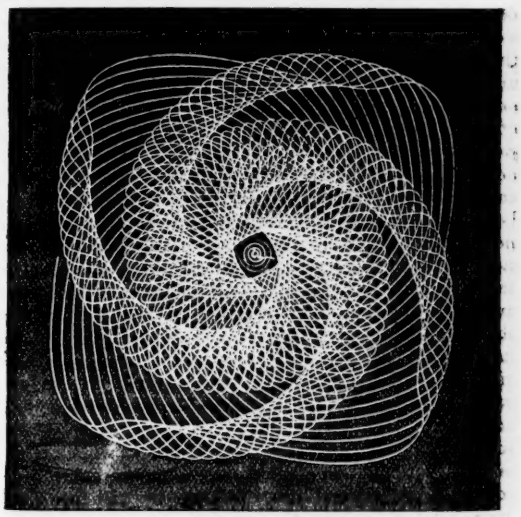
To take another instance: a transparent film, such as one of colloid silica, which cracks in drying on a glass slide, may be employed. Very clear gum or thin white varnish will perhaps do as well. The cracks are easily recognised by holding the slide against the light. One, perhaps, begins with a pretty wide fissure, and thins out to a very narrow one. The narrow part will seem, when magnified one or two hundred times linear, to be elevated like a slender rod superposed upon the slide. This will show how cautious the observer should be when studying many classes of objects.

Similar to the disputes about diatom structure are those about scales of butterflies and moths. The questions are how many membranes go to form a scale. Is there one under and one upper, or more? Are the ribs between the membranes or growths in their structure? Are the minute markings composed of dots of pigments, or of other shapes? In what plane or planes do the several formations lie? &c. When high powers are employed, and it is desired to ascertain in a very thin object what structure is on the surface and what others in successive planes below, the fine adjustment usually fitted to a microscope is not nearly so delicate as it is advisable to have it. Dr. Pigott in such cases adapts a second wheel, moving with a wonderfully fine screw of his own cutting, to the one sent out with his Powell and Lealand microscope. He can show that with a 1-16th or a 1-25th objective and a delicate object, a change of 100-1000ths of an inch in the focus produces a noticeable alteration in its appearance.

Mr. Washington Teasdale devised an excellent test-slide, helping us in these matters. One he kindly ruled for the writer consists of ten groups of parallel lines, at the rate of 2,000 per inch, disposed in a symmetric pattern of eccentric radials. The lines are ruled with a conchoidal fracture, and not a clear cut, so as to give a maximum of brilliance. This slide is to be illuminated by a spot-lens, or dark ground arrangement of condenser. If the light is exactly centred, all the bands are made to glow with equal lustre. Any slant of the light beams brings out those more plainly which lie at right angles to its line of incidence. Instead of spot-lens, or condenser, obtain a dark ground illumination from the sub-stage mirror turned strongly on one side, and then rotate the object and note the changes that ensue.

The observer will soon find that with one illumination certain bands will appear as if on a plane above the others, but by a change in the angle of illumination, can be made to look in one below them.

Most of your readers will have seen compound vibration patterns ruled with two pendulums, or with more complicated apparatus. When done on glass, on a smaller scale for viewing under the microscope, they are instructive as well as beautiful. Having been amply supplied with admirable specimens by Mr. Teasdale, the writer has been able to exhibit the wonderful perspective effects to be obtained by varied modes of illuminating them. Trial slides and damaged ones are very instructive, as any rough edges come out with so much force as to mislead the eye about their relative position.



The figure—one of Mr. Teasdale's—appended hereto, shows a pattern which is very deceptive under the microscope. It is impossible to avoid the impression that the observer is looking at a hollow object. Perspective effects, without shading, are perhaps more striking to persons who are accustomed to watch them out of doors, and also as exhibited in outline etchings A very slight guidance induces the eye to accept the idea the artist wishes to convey, and when similar guide-lines occur in a piece of mechanical ruling, their intimation is immediately followed. The subject is a very interesting one, partly optical and partly psychological. To the microscopist its study is of great importance if errors of interpretation are to be avoided. When the optical aspect is of doubtful trustworthiness, resort should be had to reasoning from analogy.

For example, the structure to be made out in the coarsest butterfly scales may help to guide to what is probable in others more difficult, and with delicate organs of insects, rotifers, &c., it is prudent to doubt any appearance that seems to contradict the general rule of such organisations. This doubt, however, must not be carried too far, and the happy mean can only be reached as the result of long study and experience.

The largest organ in the world has just been completed by Walck, of Ludswigburgh, and placed in the cathedral Church of Riga. The colossal instrument measures 36 ft. in width, 32 ft from back to front, and 65 ft. high. It contains no less than 6,826 pipes, distributed among 124 sounding stops.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

IX.

MORE graceful is the conception which makes the soul spring up as a flower or cleave the air as a bird. It is, of course, the purified survival of the primitive thought which did not limit its belief in an indwelling spirit to man, but extended it to brutes and plants, and even to lifeless things. For the lower creatures manifested the phenomena from which the belief in the spirits was inferred. They moved and breathed, their life ceased with their breath; they cast shadows and reflections; their cries, which to the savages seemed so like human speech,* awakened echoes; and they appeared in dreams. Among the western tribes of North America, the phantoms of all animals are supposed to go to the happy beasts' grounds, and in Assam the ghosts of those slain become the property of the hunter who kills them; whilst the custom of begging pardon of the animal before or after despatching it, as among the Red Indians, who even put the pipe of peace in the dead creature's mouth, further evidences to barbarian belief in beast-souls. Although such belief has now no place in serious philosophy, the belief in the immortality of brutes has been a favourite doctrine from the Kamchadales, who believe in the after-life of flies and bugs, to the eminent naturalist Agassiz, who advocates the doctrine in his "Essay on Classification;" and in a list of 4,977 books on the nature and future of the soul given in Mr. Alger's elaborate critical history of the subject, nearly 200 deal with the after life of animals. The advocates have often felt the difficulty of granting this after life to man and denying it to creatures to which he stands so closely related in ultimate community of origin; but science, while it finds links of sympathy with the ideas of rude races respecting the common life of all that moves, and presents evidence in support of the common destiny, lends no support to the doctrine of the immortality of oysters. The custom of apologising to doomed brutes is practised in regard to plants. If they exhibit the phenomena of life in a lesser degree, enough are shown to justify the accrediting of them with souls. Besides flinging wavy shadows and reflections (and it cannot be too often enforced that to the barbaric intelligence motion is a prime sign of life), they are not voiceless. Murmurs are heard in their leaves; sounds echo from their hollow trunks, or tremble, Eolian-like, through their branches; and in their juices are the sources of repose or frenzy.

"The Ojibways believed that trees had souls, and in pagan times they seldom cut down green or living trees, for they thought it put them to pain. They pretended to hear the wailing of the trees when they suffered in this way. On account of these noises, real or imaginary, trees have had spirits assigned them, and worship offered to them. A mountain-ash, in the vicinity of South Ste. Marie, which made a noise, had offerings piled up around it. If a tree should emit from its hollow trunk or branches a sound during a calm state of the atmosphere, or should any one fancy such sounds, the tree would be at once reported, and soon come to be regarded as the residence of some local god."† As expressed in Greek myth, purified in this case from grosser elements, we have the Dryades, who were believed to die together with the trees in which their life had begun to be, and in which they had dwelt. As expressed in folk-lore and its poetic forms, it is in the growth or blossoming of flowers, or the intertwining of branches, that the idea survives. In the ballad of "Fair Margaret and Sweet William"—

> Out of her brest there sprang a *rose*,
> And out of his a *briar*;
> They grew till they grew unto the church-top,
> And there they tyed in a true lover's knot;*

in the story of "Tristram and Ysonde," "From his grave there grew an eglantine which twined about the statue, a marvel for all men to see; and, though three times they cut it down, it grew again, and ever wound its arms about the image of the fair Ysonde;"† while the conception often lends itself to the poet's thoughts, from Laertes' words over Ophelia:—

> Lay her i' the earth,
> And from her fair and unpolluted flesh
> May violets spring,

to Tennyson's

> And from his ashes may be made
> The violet of his native land.

In Grimm's "Teutonic Mythology" a number of illustrations are supplied of the vagaries of popular imagination, which picture the soul as a bird flying out of a dead person's mouth, and, as a cognate example from rude culture, we find a belief among the Powhatans that "a certain small wood bird received the souls of their princes at death, and they religiously refrained from doing it harm; while the Aztecs and various other nations thought that all good people, as a reward of merit, were metamorphosed at the close of life into feathered songsters of the grove, and in this form passed a certain term in the umbrageous bowers of Paradise."‡ But many chapters might be filled with examples of varying conceptions of the soul, the major number of which (for the idea of it as a mouse, snake, &c., must not be forgotten) have as their nucleus its ethereal nature and freedom from the limitations of solid earth, although round that nucleus gather some more concrete ideas for the mind, desiring something more substantial than symbols, to grasp. The belief that inanimate things as well as animals and plants have a dual being is not so obvious at first sight, and yet, given the reasons for the latter, there are as good grounds, because like in kind, for the former. The Algonquins told Father Charlevoix that "since hatchets and kettles have shadows, as well as men and women, it follows that these shadows must pass along with human shadows into the spirit-land." When the tools or weapons are injured or done with, their souls must cross the water to the Great Village, where the sun sets. Besides, spears and pots and pans, as well as men and dogs, appear in dreams; they throw shadows and images in the water, they give forth a sound when struck, and, as the Fijians also argue, "if an animal or plant die, its soul goes to Bolotoo; if a stone or anything else is broken, it has its reward there; nay, has equal good luck with men and hogs and yams. If an axe or a chisel is worn out or broken up, away flies its soul for the service of the gods." Logically, the savage who believes that in the other world

> The hunter still the deer pursues,
> The hunter and the deer a shade,

must put in the hands of the one a shadow spear. So when an Ojibway chief, after a four days' trance, gave an account

* "To the ear of the savage, animals certainly seem even to talk. This fact is universally evident, and ought to be fully realised."—Im Thurn's "Guiana," p. 351.

† Dorman, pp. 287, 8.

* Grimm's "T. M.," p. 827.

† Cox and Jones, "Pop. Romances," p. 139.

‡ Brinton, p. 107.

of his visit to that land of shadows, he told of the hosts whom he had met travelling there laden with pipes, and kettles, and weapons. These primitive ideas explain once and for all matters which have too often been explained by fanciful theories, or cited as evidences of the benighted condition of those places which on missionary maps of the world are painted black. They disclose the reason why food, and utensils, and weapons were broken and buried with the dead; why fires were lighted round the grave; why animals were slain on the death of a chief; why the Greenlanders, when a child dies, bury a dog with him, because the dog, they say, is able to find his way anywhere; why North American Indian mothers in pathetic custom drop their milk on the lips of the dead child; and why, what seemed so inexplicable to the early missionaries to the East, ignorant of the practice of widow-sacrifice among the ancient peoples of the West, as the Gauls, Teutons, and others, wives and slaves were burned on the funeral pyre. Among the Mexicans sometimes a very rich man would go as far as to have his chaplain slaughtered, that he might not be deprived of his support in the other world.

In their initial stage all these gifts are made, all these rites performed, for the supposed need of the dead. Everything had its *manes*, which followed him into the next world, and, lacking which, he would be as poor as if in this world he had lacked it. The spiritual counterpart of the offerings was consumed by his spirit, just as the old deities were thought to enjoy the sweet-smelling savour of the burnt sacrifices; the fires were kindled that the soul might not grope about in darkness. So the obolus was put into the mouth of the dead, that its *manes* might be payment to Charon for the ferry of the Styx, as money is put in the corpse's hand or mouth among the German and Irish peasants to this day; so the warrior's horse was slain at his tomb and the armour laid therein, that he might enter Valhalla riding, and clothed with the tokens of his right to enter the abode reserved for those who had fallen in battle.

Any explanation of customs like the foregoing, persistent as they are in kind, however varying in expression, is defective which does not take into account what large parts the emotions play in all that is connected with death, and how they infuse such practices with vitality. The bereaved refuse to believe that those whom they have lost have no more concern in the interests of life once common and dear to both. As among the Dacotahs, when a mother feels a pain at her breast, they say that her dead child is thinking of her. The place where the body lies becomes the connecting link between it and the soul which is still the solicitude and care, or, it may be, the dread, of the living; succouring and protecting, or, on the other hand, avenging.

The element of dread undoubtedly comes into play early. The awe which we feel in the presence of death, or in passing in the dark through a churchyard, takes in the savage the form of terror. The behaviour of the ghost in dreams, its ability to do what men still in the flesh cannot do, quicken the belief in occult power, and the desire to propitiate it. The articles placed in the grave as gifts for the dead become sacrifices laid on the altar to appease malignant spirits; the mound or tomb becomes a temple, and awe passes by easy degrees into worship. The prevalence in one form or another of ancestor-worship has led Mr. Spencer to the conclusion that it is the rudimentary form of all religions; even sun, moon, volcano, river, &c., being feared and adored because they were believed to be the dwelling-places of ancestral ghosts. The facts are against this theory. It is to the larger, the more impressive phenomena of the natural world, the sun in noontide strength and splendour, the lightning and the thunder, that we must look for the primary causes which awakened the fear, the wonder and the adoration in which lie the germs of the highest religions. Such causes are not only sufficient, but more operative on the undeveloped intelligence than the belief in ancestral spirits of the mountain and the sea, which involves a more complex mental action.* The one is contributory, but subordinate, to the other. It is, as M. Reville remarks, "The phenomena of Nature regarded as animated and conscious, that wake and stimulate the religious sentiments, and become the objects of the adoration of man. . . . . If Nature-worship, with the animism that it engenders, shapes the first law to which nascent religion submits in the human race, anthropomorphism furnishes the second, disengaging itself ever more and more completely from the zoomorphism which generally serves as an intermediary. This is so *everywhere*".†

THE PHILADELPHIA INTERNATIONAL ELECTRICAL EXHIBITION.

THIS Exhibition was opened by Prof. Rowland on the 2nd ult. Referring to it, the *Scientific American* says:—Probably at no other exhibition held in this country was foreign workmanship so readily distinguished from domestic. We are a practical people, and we are not always disinclined to boast of this practicality, but as we look over the European exhibits in this exposition, observe the nicety of the philosophical apparatus and instruments of precision, consider the carefully worked-out theories and laws upon which they are constructed, and then turn to our own exhibits, confined as they are almost exclusively to practical applications for money-getting, it seems after all as though we had been better off were we not quite so practical, and loitered a little more in the paths of pure science.

The arc and incandescence lights of the various systems which ornament the pillars and hang in festoons from the walls have resulted from the application of laws discovered by Faraday and Oersted; and while the inventors of these applications have deservedly won no little fame and are credited with making a deal of money, the men without whose efforts such applications would have been impossible gained little of the former and scarcely enough of the latter to insure them a livelihood.

The principal objects sought by that admirable society, the Franklin Institute, under the auspices of which the present exhibition is given, might, perhaps, be fairly laid down as—1. To give the American electrician the opportunity to compare his work not only with the latest European models, but also with the handiwork of his fellow on this side the water. 2. To exhibit the excellence of American electrical applications.

In regard to the first, it is well known that many practical and ingenious workmen are in the habit of keeping to themselves for fear their ideas should be taken from them. That this is, in great part, a mistake is well illustrated by the small number of really successful applications in electrical science compared with the number of workmen that have struggled tirelessly over what has not given, nor is likely in the future to give, much promise of success. These men, or some of them, are searching for that which is not, or for that which the interposition of a

* Cf. KNOWLEDGE, Sept. 21, 1883.

† "Hibbert Lectures," 1884, pp. 39, 40.

natural law prevents them from finding, at least in the manner they have proposed to themselves.

The opportunity of seeing what has gone before, what has already been done, and for mutual comparison of work, is likely to be of inestimable advantage, and the collection at one point, as at the present Electrical Exposition, of working models of the best construction up to date must, for reasons so obvious as not to require demonstration, be of incalculable assistance to the struggling and ambitious electrician and mechanician. As to what may be regarded as another principal reason for the exposition, viz., the exposure of domestic wares to a foreign audience interested in enterprises for which they are designed, much might also be said. Novelties require more than a casual introduction into a new market. A supply will not always insure an immediate demand. There was no demand for india-rubber goloshes, but the practical demonstration of their usefulness begat a demand. The case of the telephone is a striking illustration of this. Though now known to be a commercial success in the broadest meaning of the term, its usefulness, speaking from a purely commercial standpoint, remained for a long time unrecognised abroad. More than fifty million dollars had been invested in this country in the telephone plant ere it really went into general use abroad.

For these and other reasons the present exposition is likely to further the interests of American electricians, mechanics, and manufacturers, and they have reason to congratulate themselves that it was planned and is now being managed by so estimable a society as the Franklin Institute.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued from p. 235*).

THE evidence already obtained respecting the earth's figure points so clearly to its being a globe, that the observer would now direct his attention simply to determine the size of other circular sections than those he has already traversed. He first starts eastward or westward from different parts of the north and south line he first surveyed; and then he starts northwards or southwards from different parts of any of his east and west journeyings.

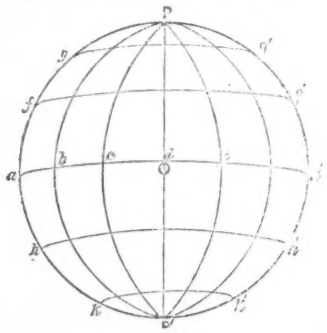


Fig. 1.

By doing this he obtains the most complete and satisfactory evidence of the true figure of the earth; because he finds every north-and-south journey, as P *a* P′, P *b* P′, P *c* P′, &c. (Fig. 1), indicating a circular section having a radius of about 7,900 miles, and every east-and-west journey, as *a a*′, *f f*′, *g g*′, &c., indicating a circular section having a radius proportioned to the distance from the axis P O P′.

Now it must be remembered that, though no person ever carried out such a series of journeys as I have described, yet the various measurements and journeyings made by men over the earth amount even to a more exact and convincing demonstration of the earth's figure. In all parts of the world, in the southern as well as in the northern hemisphere, there have not only been scientific investigations directed to the determination of precisely those points which we have imagined our observer to have inquired about, but the theory of the earth's globular figure has been submitted even to more crucial tests. The sailor voyaging in the southern seas, for instance, estimates his progress strictly according to those results which follow from the globe-figure of the earth. When, for days together—as frequently happens—the sky is so clouded as to give him no opportunity of observing the celestial bodies, he trusts altogether to his estimate of the rate and direction of his voyaging, combined with his knowledge of the shape and size of the earth. If there were any error in the estimates which astronomers have made on this point,* it would be more fatal to the seaman than the most terrible storm-seasons could possibly be.

But, after all, it is to the careful observations carried on by men of science, according to the principles involved in our observer's plan of voyaging, only with a degree of nicety which no single observer could ever hope to obtain, that modern views respecting the true figure of the earth owe their exactness. The measurement of degrees in longitude or in latitude means nothing more than the comparison between the distances travelled either north and south or east and west, with the observed change in the elevation of the pole of the heavens or in the moment of the stars' meridian passages. Our observer effected this comparison roughly—he trusted to a simple contrivance for estimating the elevation of the pole, and to a single chronometer carried from place to place for his estimate of absolute time. But modern astronomy determines these things with an accuracy which is inconceivable by those who have not studied the appliances by which it is secured. The mural circle by which the astronomer measures the elevation at which a star crosses the meridian, has occupied as much attention as the finest piece of machinery ever erected for manufacturing purposes. I can imagine no greater treat for an appreciative mechanical mind than the examination of the multiplied contrivances by which perfectly accurate movements are imparted to the heavy mural circle of a large observatory. The exceeding delicacy of the means by which the instrument's indications are read off is equally surprising and interesting. Then the transit-instrument by which the time of a star's passing the meridian is taken is well worth studying. The easy swing of the instrument in the meridian-plane, the perfection with which it sweeps out that plane, the delicate spider-webs by which the passage of the star across the field of view is measured—all these, and many other matters, serve to show how anxiously the astronomer aims at exactness.

By observatories set up all over the earth, by voyages expressly undertaken to determine the figure of our globe, and by a long and patient scrutiny of all the evidence obtained, the modern theory of the earth's figure has been established. I have hitherto spoken of that figure as globular, and very delicate observations indeed might be

* A paradoxist, who should be the prince of his peculiar people, seeks to prove that the earth is plane, with only one pole—the north pole—and for his purpose it is necessary that the latitude-circles in southern regions should be very large. So he extracts a passage from Ross's "Antarctic Journeys," in which a bottle is said to have floated so many miles in travelling between two places some 120 deg. apart; and thus the length of a degree is calculated on a conveniently large scale. *No mention at all is made of the fact that Ross distinctly speaks of the bottle having been carried the long way round!*

made over the whole surface of the earth without proving anything beyond this. But the observations made by astronomers have attained so great a degree of delicacy as to show how far the earth's shape departs from the figure of a true sphere. Slight differences in the rate of elevation or depression of the pole as the north and south journeys have been carried out, have shown that the curves P *a* P′, P *b* P′, &c. (Fig. 1), are not true circles; though differing so little from the circular figure, that if their true shape were drawn down on paper, a very sharp eye indeed would be required to detect the difference between their figure and a perfect circle. They are slightly elliptical, P P′ being the shorter axis of each. In other words, the earth is somewhat flattened at the poles.

My aim is, however, to give an exact account of the simpler features of the earth's figure, rather than to deal with minor peculiarities, and as the departure of the earth's figure from the true sphere belongs to the latter order, I need not discuss this feature farther.

I conclude this chapter by mentioning certain phenomena which afford tolerably clear evidence of the globe figure of the earth, though I may remark, in passing, that nothing but the complete survey described above can be held to be a satisfactory proof.

Every one who has ever been at the sea side on a fine day, has noticed how clear-cut the horizon-line is, how it forms a well-marked line against the sky. How this circumstance rightly understood gives very forcible evidence that the visible part of the earth's surface is globular. If, on the contrary, it were plane, then, however little the eye were raised above the surface of that plane, yet every part of the plane would be visible; and the appearance of a well-defined horizon-line would imply that we were looking at the actual limits of the plane in that direction, which is obviously absurd. If the plane had no limits within the range of vision, the appearance presented would be that of a gradual fading away up to the horizon level.

When, however, we find further that at the sea side ships pass that apparently well-defined border-line, and gradually seem to sink out of view, no doubt can remain that the visible surface is not plane. For we see distinctly the clear-cut water-line across the equally well-defined masts and sails of the ship. We know, therefore, that the ship is *beyond* the water-line, and as we know that it has not crossed a limit of any sort, no other explanation is available than that it has sailed over a continuously curved surface.

The conviction thus arrived at hardly admits of being strengthened, but those who have ever used a powerful telescope at the sea side find a certain new interest in observing this well-known phenomenon. It may seem a simple amusement for a student of astronomy, but often when I lived by the sea side, I used to watch with my 4-in. achromatic the gradual disappearance of a ship beyond the sharply cut border-line of the sea with much interest and pleasure. Sometimes the air would be so clear that a tall ship would sink until her upper masts would be out of focus when the sea horizon was brought into focus, and *vice versâ*. A slight motion of the focussing rack-work would bring either the sea-waves or the masts and ropes into focus, as might be wished: a very pretty and simple proof, by the way, of the relative distances of the sea horizon and the ship, and a supplementary evidence of the earth's globular figure, which so far as I am aware has never yet been noticed.*

Another proof of the globular figure of the earth has been derived from the shape of the earth's shadow as seen during a lunar eclipse. This proof is not perhaps very striking, because the curvature of the earth's shadow as seen on the moon is by no means so well marked as many suppose. The shadow has not a well-defined edge, the circle it belongs to is much larger than the moon, and finally the moon's surface is marked with so many variations of brilliancy as to confuse the border of the umbra.

The *real* evidence derived from lunar eclipses is, however, much more striking when it is properly studied. Let it be remembered that the astronomer calculates the minute at which a lunar eclipse begins, and the place at which the earth's shadow at first makes its appearance on the lunar disc, on the hypothesis that, the earth being a globe, the section of the shadow-cone where the moon crosses it is a circle of a certain size, and in no single instance has his trust in this hypothesis been confounded by the eclipse either occurring at the wrong time, or commencing at the wrong part of the moon's disc.

Fig. 2.

A peculiarity noticed by balloonists seems at first sight strikingly opposed to the theory that the earth is globular. When a balloon has risen high above the earth on a clear day, the latter appears to the aëronauts to be shaped like a basin beneath them, the sky assuming also an appearance of concavity (more flattened than usual), facing the earth's apparently hollow surface. Many balloonists have been so struck by this appearance, which is represented in section in Fig. 2, as to think there must be something wrong about the theory of the earth's globular figure. In reality, however, the appearance is precisely what was to have been expected. The balloonist, even after rising four or five miles, has scarcely caused the visible horizon to appear appreciably below his level. It is, in fact, lowered some $3\frac{1}{2}$ degrees, but the unaided eye cannot recognise so small a depression, whereas the vast gap which separates the observer from the earth beneath him is very obviously presented to the eye. Therefore the effect is as though the horizon were on a level with the eye, and the earth's surface under the observer far below that level.

Of course if the peculiarity proved anything, it would show that the earth is basin-shaped, certainly not that it is plane. As yet, however, no one has claimed for the earth the figure of a basin.

(To be continued.)

* Perhaps I should not have had my attention called to the fact that the distance of the visible sea-horizon is measurable in this simple way, had it not been for the blatant assertions of a well-known charlatan, that a telescope will bring a ship into sight which has passed beyond the visible horizon. Certainly this man never did a bolder thing than in coming to a sea neighbourhood, and there making an assertion so easily disproved. He told the Plymouth people that he could show them the Eddystone Lighthouse as clearly from the foot as from the summit of the Hoe, and on a certain clear, calm morning in autumn he carried out the experiment. Of course, he failed. But if that were all I should have left the story untold. The best is to come. One might suppose he would have blamed his telescope, though it had shown the Eddystone nicely from the summit of the Hoe. He was too sharp for this, however. It happened that the atmospheric refraction (which is well known to be variable) was unusually weak that morning, and so the lantern of the lighthouse was altogether out of sight, when, according to the Admiralty instructions (calculated for average refractive effects), it should have been partly visible. Here was a means of escape. "I promised to show you the Eddystone," he argued, "though the Admiralty says all but the lantern would be ought of sight. Well, you see the Admiralty is wrong; not even the lantern can be seen. Is it not obvious that the received theory is false?" I am told he even published this argument in a book.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page* 258.)

TO return to the conversation between Grewgious and Jasper.

Jasper asks, "What is Miss Landless's state?" To this, Grewgious replies at once, "Defiance of all suspicion and unbounded faith in her brother." And, when Jasper pretends to pity her, Grewgious turns, as if in disgust with Jasper, from the subject. "It is not of her that I came to speak," he says. "It is of my ward." And he proceeds to tell Jasper of the dissolution of the engagement between Edwin and Rosa. Now, here I notice a singular thing. Every reader knows why Jasper is overwhelmed by this intelligence. Jasper learns that he has murdered Drood uselessly, and, murderous villain though he is, he is horrified. But no one seems to notice that Grewgious has no special reason, unless he is certain that Jasper believes himself to be the murderer of Drood, for supposing that Jasper will be startled by the news he brings. Yet he does suppose so. He says, "Mind! I warn you that I think it will surprise you," which, from Mr. Grewgious, means a good deal. Again, it is "with a compressed and determined mouth" (which, from Dickens, means a good deal), with provoking slowness and internalness, with fixed look on Jasper, *never changing either his look or action in all that followed*, that Grewgious tells Jasper what, unless Grewgious knew of Jasper's assault on Drood, would seem to him a matter of very little moment at such a time,—savouring of triviality in the presence of the presumed fact that Drood was dead.

That no one should notice the strangeness of this expectation on Mr. Grewgious's part seems to me even more singular than the circumstance, which nevertheless is to me very singular, that few seem to be struck by the strangely brutal behaviour of Mr. Grewgious—or rather by what would be its strange brutality if he were not certain that Jasper was a murderous hypocrite. It is to be observed that Mr. Grewgious's intense dislike to Jasper, shown in this interview and afterwards, has sprung into existence full-grown. There is no trace of it in the earlier and only other meeting between the two. On the contrary, in that meeting, after answering rather sharply a remark of Jasper's which had seemed unnecessary, Mr. Grewgious says, all earnestly and sincerely, "Come, Mr. Jasper, I know your affection for your nephew, and that you are quick to feel on his behalf." "You could not speak more handsomely," Jasper says; on which Mr. Grewgious nods his head contentedly. The rest of that interview is friendly and pleasant; and we note especially that Mr. Grewgious shakes hands with Jasper at its close, as he says of Drood and Rosa, "God bless them both!" But in the interview on Dec. 27, just after Jasper has had so terrible a blow in the loss of the nephew whom Grewgious supposed him to love so much, Mr. Grewgious, so far from sympathising with him, treats him as the "brigand and wild beast" he afterwards calls him. He tells him news which—*somehow*—he knows will horrify him, and as Jasper sinks under the blow he looks on unpitying. He tells him how Edwin and Rosa grew to the idea that they should rather be as brother and sister than as husband and wife; describes how they met for the purpose of interchanging their discoveries; notes how "one of the couple, and that one your nephew," showed such consideration for Jasper as to be enabled to inflict on him the shock of hearing of the parting: and as item after item is slowly brought before him the villain reels and staggers under the successive blows. Then finally he is struck to the earth by hearing that the parting he had witnessed (Grewgious must have learned this after Edwin's disappearance) was final—so far as their ill-advised relation was concerned. As Jasper falls with a terrible shriek in a ghastly heap upon the floor, Grewgious shows no pity —"not changing his action even then, he opens and shuts his hands as he warms them, and looks down at it."

Is it *possible* to explain this except on the assumption that Grewgious *knows* Jasper to be the murderous hypocrite he is? Without hesitation, I say, it is not. Nor can he possibly have known this except from Edwin Drood himself.

Now note that when Jasper comes to he finds Grewgious watching him, as calmly as before. "A man," Grewgious remarks, "cannot have his rest broken, and his mind cruelly tormented, and his body overtaxed by fatigue, without being thoroughly worn out." "I fear I have alarmed you," says Jasper. "Not at all, I thank you." "You are too considerate." "Not at all, I thank you." (Words full of meaning here.) Mrs. Tope gets wine and food ready, and invites Mr. Grewgious to wait till Jasper has taken it. He replies, "with a snort which might mean yes, or no, or anything, or nothing, and which Mrs. Tope would have found highly mystifying, but that her attention was divided by the service of the table," but which the average reader, whose attention is very readily divided, finds not mystifying at all, but simply passes without considering it as worth noticing. Then Jasper asks Grewgious to eat with him. "I couldn't get a morsel down my throat, I thank you," answers Grewgious. He will not eat at the same table with Jasper, whose hand but a few days before he had been willing to take. He sits "with a hard kind of imperturbably polite protest all over him." This again is full of meaning. He is all hardness, and shows no trace even of sorrow, still less of sympathy.

After his meal, and a few minutes' meditation, Jasper begins to see that a part of his plot will fail, unless he can bring new evidence against Neville. He tests the matter by submitting to Grewgious the idea that Edwin may have been moved by his changed position to go away from Cloisterham. Nor does Grewgious reject the idea. He purposely assents to it, waiting to see what the villain aims at. This soon becomes clear. Crisparkle enters, and Jasper suggests the same idea to him, with an air of fairness which thoroughly deludes the simple and kindly-hearted clergyman. Crisparkle immediately opens his heart, and tells Jasper what was doubtless no news to him, but what—once made public—must tell heavily against Neville. He describes the hopeless love entertained by Landless for Rosa. Jasper turns paler as this love is spoken of, but we feel that he had known of it before. He repeats that he will cling to the new hope; and that if no trace of Edwin is found, he will cherish the idea that Edwin "might have absconded of his own wild will."

And now follows a passage which, like many of the most significant passages in the story, has been very little noticed, if noticed at all:—

"It fell out"—whenever Dickens begins thus we know something important is coming (as I could show by a hundred instances)—"it fell out that Mr. Crisparkle, going away from this conference very uneasy in his mind . . . . took a memorable night walk." Observe, a *memorable* walk—though nothing seems to happen, except that strange thoughts come into his mind. "A familiar passage in his reading, about 'airy tongues that syllable men's names,'

rose so unbidden to his ear, that he put it from him with his hand, as if it were tangible." He can neither see nor hear aught unusual; yet he has "a strange idea that something unusual hung about the place." He strains his keen ears and his hawk's eyes. Nothing in the least unusual was remotely shadowed forth." But he resolved that he would come back early in the morning.

In the morning he finds the watch, chain, and pin. In a sense, his walk overnight was made memorable by the morning's discovery. But was that all which made the walk memorable? He might have found these things without that night walk. I take it the walk was memorable for other reasons. Jasper was there. Probably Grewgious, too, was there, watching Jasper, when Crisparkle had that strange sense of something unusual. Jasper waited till Crisparkle had gone, and then,—under the very eyes of Grewgious,—placed the watch and chain among the interstices of the timbers, and flung the shirt-pin into the pool. If it could be proved that the watch was kept unwound from Christmas night when it ran down to midnight on the 27th, much would be made thereafter of the events of that memorable night.

(*To be continued.*)

THE INTERNATIONAL HEALTH EXHIBITION.

XVIII.—THE SOFTENING OF WATER—(*continued*).

AMONGST the many processes that have been invented to superinduce the condition through which hard water is fitted for manufacturing purposes there are a certain number still in general use which call for some notice in connection with the subject of these reviews, because they are calculated to retard the progress which it has been the aim of the modern inventor to substantiate. Water ought to be pre-eminently soft to be of the greatest value to the engineer, and when we recorded the results of Mr. Porter's improvements on Dr. Clark's softening process we intended to convey the notion that its utility lies in the fact that it *eliminates the causes* of hardness in accomplishing its results, and does not seek to do so by merely correcting the evil influences of a pernicious supply.

The inefficient methods to which we have just alluded may be classed together as anti-crustation reagents, which act in two ways—viz., either mechanically or chemically. To the former group belong clay, sand, powdered glass, &c., which are introduced directly into the boilers; they are there held in suspension by the ebullition of the water, and are useful, inasmuch as they prevent the consolidation of such salts as are apt to accumulate into a compact incrusting layer. They are to be discarded, because of their tendency to add to the local heating of boiler-plates, to waste of fuel, and to increased wear and tear of the internal parts of the engine. These disadvantages are but slightly modified in the employment of dissolving or emulsifying solutions such as of potato-pealings, starch, dextrine, &c.; or of tannin-bearing compounds, particularly of logwood, cashoo, sumach, tan, and chicory. Other reagents, which enforce a precipitation of dissolved salts and thereby prevent incrustation have also been used; amongst them are salts of baryta, caustic alkalies, and alkaline carbonates, which are introduced at intervals or continuously into the boilers along with the feed water. It is true that they prevent incrustation, and by so doing enable the boilers to be easily cleansed; but insuperable objections arise in the corrosion of taps, and the formation of soap and priming. Innumerable patents have been taken from time to time, with a view to prevent the dangers arising from the use of hard waters, but although some of them are more valuable than others, they are all alike to be condemned on the score of treating an evil, or rather of permitting an evil which could be obviated. One of the most recent and successful appliances used, however, deserves mention on account of its novelty. It is known by the name of Field's Electrical Scale Preventer, and, as its title implies, the formation of adhesive crusts is prevented by the precipitation and immediate removal of the causes of hardness along currents induced by means of electricity.

So serious in its results has the hardness of water been to engineers, that they have even resorted to the modification of their machinery; to the superaddition of separate depositing vessels, and to the employment of feed water-heaters or economisers to relieve them. The only rational system, however, which cannot by any possibility be open to objection, ought to be looked for in a sufficiently inexpensive process for the removal of the undesirable impurities.

Scarcely a year has passed since 1849 without the introduction of some patent for the softening of water, and that alone suffices to prove the importance of the case. The principal aims of such a process are efficiency and cheapness, and that they have at length been attained is attested to by the existence of the Porter-Clark, Atkins, Gaillet and Huet, and Maignen's processes, all of which differ from one another in the working out of details rather than in essentials, and all of which are based on Professor Clark's original researches, an excerpt of which we gave in our last.

An excellent *condensé* of the Atkins, and Gaillet and Huet processes * is given in Mr. Baldwin Latham's paper,† read to the Society of Arts Water-Supply Conference, recently held at the Exhibition; and for the benefit of our readers we shall conclude our remarks for the present by quoting Mr. Latham's observations in their entirety.

"*The Atkins' Process* is also a modification of the Clark process, by which the space formerly required is reduced. The lime is put into a vessel where lime-water is formed, and this water is allowed to mix in its proper proportion with the water to be softened in a specially-arranged mixing-vessel, after which it passes into a reservoir of small dimensions. From this reservoir it is conveyed to filtering vessels which contain a special arrangement of filter, consisting of a series of chambers mounted upon a central hollow shaft, these disc-chambers being covered with prepared canvas, upon which the deposit of chalk, &c., adheres, and through which the softened water filters. These filters are cleaned by means of revolving brushes. The apparatus does not require power to maintain it while at work, the only power used being that necessary to give motion to the brushes when the apparatus is cleansed. The system may be seen at work at the Henley-on-Thames Waterworks and at other places."

"*The Process of Messrs. Gaillet and Huet.*—In this process, which was patented in February, 1883, the patentees make use of certain known agents, the patent itself applying to the apparatus used for the purpose of producing the results after the chemicals have been applied. The agents they propose are lime and caustic soda. Whenever the water contains organic matter, they use salt of alumina or iron in addition. Iron, however, is not recommended in

* A full account of which may be found in a small pamphlet on "The Softening of Water," by Andrew Howatson, C.E., 11, Queen Victoria-street, London, 1884, being an extract from "Étude sur les Eaux Industrielles et leur Épuration," by Gaillet and Huet.

† "Softening of Water," July 25, 1884, Health Exhibition Conference.

any case where the water is required for washing purposes. The apparatus consists, virtually, of a series of tanks in duplicate, in which the chemicals are mixed, and these enter a vertical pipe in proper proportion to the water to be softened, and which communicates with the bottom of an upright chamber divided by a series of sloping shelves through which the water gradually works up in a zig-zag path. These shelves slope in one direction, and are of V shape, so that as the deposit takes place, it accumulates at one point, at which there is an opening ordinarily closed by a tap, and when any tap is open the deposit on the sloping shelf communicating with it is washed out. The apparatus appears to be extremely simple in its design, but its efficiency has yet to be tested, although it is at work at Messrs. Duncan's, Victoria Docks."

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p.* 199.)

SO far, we have spoken as though vision were confined to a single eye; but, of course, under all ordinary circumstances, we have, and employ, two. Let us then see whether this makes any difference (and if so, what difference) in our perception of external objects. Speaking off-hand, any one who has never had his attention especially directed to the subject would say that vision with two eyes is essentially the same as that with one, for that we only see one image of any given object, whether we regard it with the right eye, the left one, or both together. But a little attention will suffice to convince us that this is by no means the case, and that binocular vision supplies us with a means of estimating solidity, distance, &c., which is wholly wanting in the case of sight with a single eye. Observe especially though that *the two eyes must act together as one instrument.* A dragon-fly has an immense number of eyes (some 24,000), but they are looking different ways and forming images of different objects, so that the advantage and peculiarity of binocular vision proper is wholly lost. In order that it may be enjoyed, the images formed by both eyes must be superposed, and caused to coalesce into one. Now, so entirely accustomed are we to this coalescence of the optical images formed by our two eyes, that it requires a certain amount of thought to perceive and convince ourselves that we really do see everything in reality double. As a preliminary experiment to show this, let the reader hold a common drawing-pencil a foot or eighteen inches in front of his face, and look, not at the pencil itself, but at the further side of the room, or at the horizon, and he will at once see two pencils. By first closing one eye and then the other, he will immediately discover that one of these images is referable to the right eye, and the other to the left one. The fact is, that by adjusting the eyes for distant vision we have thrown the images of the pencil upon different points of the two retinæ, and in order that they should coincide they must be made to fall upon identical points in each eye. A more instructive experiment still, however, in connection with binocular perspective, of which we are immediately about to treat, may be made with a thin book. Holding such a one as near to the eyes as is consistent with distinct vision, exactly half-way between them, and with the back of the book towards us, and first shutting the right eye, we shall see the image L (Fig. 27) with the left one—*i.e.*, the back and left-hand side of the book. Closing the left eye now in turn, and opening the right one, we shall see the image R, or the back of the book and the right side of it. Now here we have made a discovery. It is this: that the images of an object, at a short distance from the observer, are dissimilar, and yet that the eyes unite these two dissimilar images into one, which appears *solid* as well as single. A little attention will show us what it is that gives us this impression of solidity; and this being comprehended, the principle of that pretty toy, the stereoscope, becomes intelligible at once. If, first, as in the case of our pencil, we look at the opposite wall of the room, or at the distant landscape, we see two separate books. Next, if we look at the part of the book furthest from us, the two images will unite, but the book will seemingly have two backs. While, lastly, if we direct our attention fixedly to the back of the book, we shall see only one back; but the part furthest from the eye will now become double. If, however, we take, so to speak, a general view of the book, the eyes will range rapidly over it, and the result of successively combining the images at various distances will be to impress us with the conviction that the book is a single, solid object. In making this experiment carefully, the student will note that the eyes converge, or he has to squint, more to cause the images of the part nearest to his eye to coalesce than he has to cause the combination of the more distant one; such convergence decreasing as the parts recede from the eye; so that at a certain distance no convergence at all is needed to unite the two separate images of any given object. It will also be noticed that the farther an object is from the eyes the less dissimilar the images they respectively form become, until beyond a certain distance they are sensibly identical. And here we are in sight of the principle of the stereoscope. As far as the eyes are concerned, it matters nothing whether they see two slightly dissimilar images of the same object, or whether two images from two separate objects are presented to them, so long as the latter resemble the former in all respects. All that is needed is that by appropriate means these two images should be caused to overlap

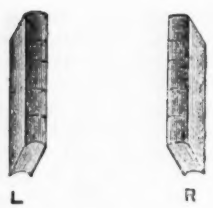


Fig. 27.

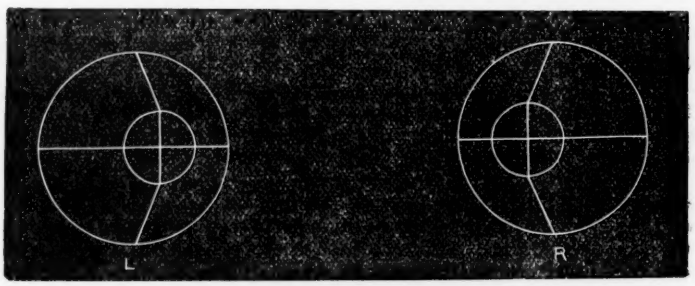


Fig. 28.

and coalesce. This may be effected in the case of drawings or photographs, after a little practice, by squinting. Fig. 28 will illustrate this. It represents a truncated cone, or cone with its sharp end cut off, as seen by the right and left eyes respectively. If now the reader will get a strip of cardboard (preferably of a dead black) about a foot long, and place it on end half way between L and R in our figure, with the other end against his forehead and the root of his nose, so that R is visible only to the right eye and L to the left one; then, on looking, so to speak, at a point far on the other side of this page, the two images will be seen to run suddenly into one, and a startlingly solid little cone will seemingly rise out of the paper. As we have said above, the little circles require greater convergence to make them coalesce than the larger ones, and so are felt to be nearer to the eye, the result being the illusive conviction that we are actually regarding an objective skeleton cone. A careful examination of a photographed stereoscope-slide

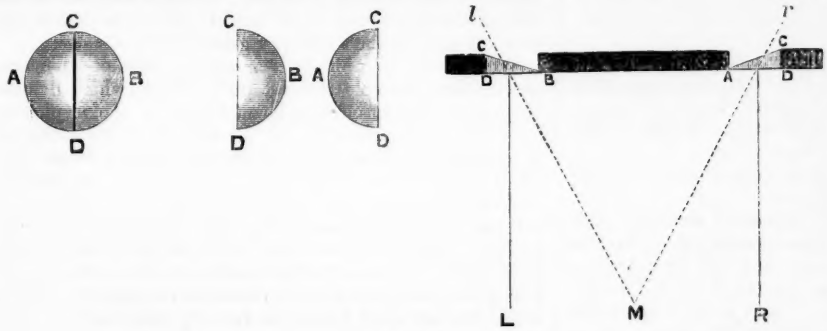


Fig. 29.

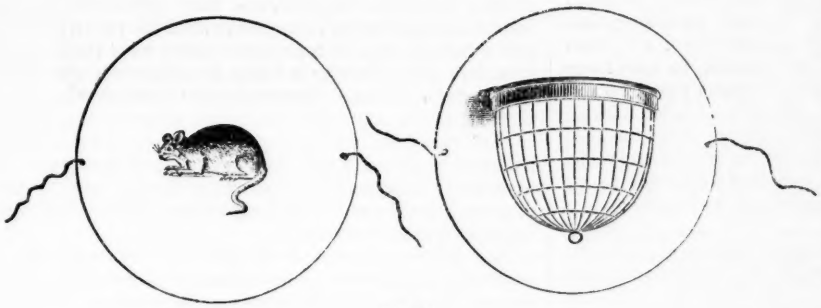


Fig. 30.

will show the dissimilarity of the images of objects in the immediate foreground, and their absolute identity in distant ones. What we have effected by squinting, the lenticular form of stereoscope devised by Sir David Brewster (with which, at all events in its outward form, probably every reader is familiar) does in an even more simple and convenient manner. If the reader will turn back to page 46 and trace the course of a sheaf of rays through a convex lens, he will be prepared to understand the principle of this stereoscope at once. For we simply take a convex lens, like A C in Fig. 19, cut it in half across a diameter B C, and so set the two halves in a frame, the width of the eyes apart, that the sides A and B shall be inward, or next the nose. The left-hand part of Fig. 29 represents the lens as viewed from the front before its halves have been separated. The middle one shows the two halves in plan in the position they occupy as the eye-pieces in a stereoscope. The right-hand diagram exhibits them in section, and shows how they act. Turning to Fig. 18, p. 46, for an illustration of the course of a ray of light through a prism, it will be seen at once in Fig. 29 that a ray coming from the left-hand picture L will be refracted by the prism A C D to *l*, and, of course, be referred by the left eye to M; while the ray from the right-hand picture R will, in like manner, be refracted to *r* by the prism B C D and equally referred to M by the right eye, the illusive impression of solidity from the coalescence of the two slightly dissimilar pictures thus seemingly both emanating from a single object at M being perfect. It is needless to pursue this branch of our subject here, enough having been said to show how it is that we derive the impression of solidity from binocular vision, and how perfectly the sense of sight may be deceived by the presentation to the two eyes of accurate simulacra of the images which they would receive from a material object.

A ridiculous deception incident on our seeing two images was described by Mr. T. Foster on p. 244 of our first volume, to which the student is referred for an experiment as instructive as it is absurd in its effect. Another peculiarity of vision, or properly of the retina and optic nerve, is at the bottom of several familiar optical phenomena and visual deceptions. We refer to the retention on the retina, for something like the tenth of a second, of the impression of an object, after that object has passed away or been otherwise hidden. Observe particularly that it is by no means necessary that any given object should remain before the eye for such an interval for its original *perception*. So far from this being the case, we distinctly see a flash of lightning, whose duration was shown by Wheatstone to be less than a single thousandth of a second. Once seen, however, the image persists for the time first specified. Probably the best-known and commonest results of this is that when we wink we do not lose sight of the objects at which we may happen to be looking; their images continuing to impress the retina for the very short interval during which the eyes are closed in the act. It is, of course, this temporary persistence of the images of external objects which is an integral element in the explanation of the illusions we experience with such toys as the magic Wheel (KNOWLEDGE, vol. i., pp. 198, 199, and 247), the Strobic Circles (*Id.*, p. 422), and the so-called Zoëtrope (or Wheel of Life), in which such figures as those shown on pp. 199 and 247 of our first volume are placed round the interior of a cylinder, in which slits are cut, and the figures viewed through these slits from the outside as the cylinder rotates, thus dispensing with a looking-glass. The boy's experiment of whirling a lighted stick about, and producing the semblance of a continuously-curved line of light also depends upon this property of the eye, which may be further illustrated by a very simple contrivance (shown in Fig. 30), popular in the days of our fathers, and known

as the thaumatrope. It consists of a circular disc of stout white card, upon one side of which we have shown a drawing of a mouse, and on the other one of a cage, which must be drawn upside down, as referred to the first figure. At the sides of the discs are two strings, which are held between the forefinger and thumb of each hand, and twirled rapidly round, the effect being that we see the mouse in the cage. We may, of course, draw in the same way a man on one side and a horse on the other, a tight-rope dancer and his rope, and so on. We may add that if the strings by which the card is twirled be not on a diameter, so that the card does not rotate about its principal axis, the figures will be displaced, so that we may have our mouse either on his cage or under it instead of in it, by a suitable arrangement.

GRASS OF PARNASSUS.

By Grant Allen.

As we have been going in lately for a course of coincidences in Knowledge, I will begin this paper with a sufficiently curious one which happened to me during my summer holiday the other day in Norfolk. I had walked over by the breezy cliff path from Cromer to Beeston Common, and had been diligently investigating for a whole sunny afternoon the exceptionally rich boggy flora of that pretty bit of deep, waterlogged moorland scenery. The ground, for acres together, was covered with pale yellowish-green rosettes of tufted butterwort, and tall lush trefoils of beautiful buckbean, and golden clusters of belated marsh marigolds, blossoming still out of due season. But the prettiest flower in all the wide stretch of swampy vegetation was the white grass of Parnassus, whose exquisite veined blossoms starred the soil on every watery patch in the most astonishing profusion. I stood for a long time watching the flies buzzing idly around them, and then picked a number out of pure wantonness, to take home with me as an appropriate tribute to a great poet who was staying in the neighbourhood. As soon as I got back, I put the drooping flowers in water, and proceeded to open the letters which were waiting for me on the parlour table. The first one at which I looked had been forwarded to me by the Editor of Knowledge, and it ran as follows :—

> Sir,—Would Mr. Grant Allen or any of your botanical contributors kindly state what useful object (if any) is attained in *Parnassia palustris* by the very curious development of its imperfect stamens, and oblige A Student of Botany?

Clearly this was the finger of fate. *Parnassia palustris*, with its abortive stamens, was staring me in the face from the glass in front of me; and I had been spending all the afternoon in watching the flies in the very act of being taken in by the deceptive staminal organs in question.

First of all, then, let me begin by briefly describing this grass of Parnassus. It is a marsh-land plant, of the saxifrage family, having some affinities with the sundew, but even more (as has been recently shown) with the true saxifrages and chrysospleniums. From a small tuft of heart-shaped, glossy-green, radical leaves, a rather tall scape rises abruptly, enclosed half-way up by a curiously clasping leaf, and bearing at its summit a single, large, snow-white flower. The blossom has five petals and five perfect stamens; but the place of the five inner stamens (which occur normally in the saxifrages) is taken by some very strange abortive organs, at the base of the petals, split up into eight or ten short, spreading filaments, and terminated at the end, where the anther ought to be, by a little, yellow, shining, globular gland. So very bright and glassy are these tiny balls that they look for all the world exactly like a drop of liquid; and the imitation goes so far that even when one has touched them with one's finger it is difficult to believe they are not really glistening drops of limpid honey. These are the organs whose use and function "A Lover of Botany" wishes to learn about.

It was Hermann Müller who first pointed out the true meaning of these odd staminodes. They are really deceptive organs, which attract flies and other insects by the fallacious appearance of a store of honey. "The yellow knobs placed at the ends of the hairs," says Müller, "look so extremely like drops of fluid that it needs close examination to convince one they are thoroughly dry. An observation of my son's proves that even flies are taken in by the appearance of liquidity. He saw from a short distance a specimen of *Eristalis nemorum* trying to lick these bodies for a long time, until at last it flew away on his coming closer." I myself observed exactly the same thing several times over at Beeston Common; the flies alighted on the disk of the pistil, and tried hard to lick honey, over and over again, from the small, dry glassy bulbs.

We have thus, as Müller remarks, in grass of Parnassus an excellent example of a deceptive flower, which deludes the foolish flies by offering them a number of conspicuous but sham drops of honey. At the same time, the deception is not quite absolute, for the staminodes have a broad base, which secretes two small lots of nectar in two shallow depressions on its inner side. This honey is sufficient to prevent the flies from altogether discovering the imposition, and giving up the hunt in future as useless. After long and vain attempts to find nectar in the deceptive glands, they are at last rewarded for their pains by a much smaller store laid by in the depressions at the base of the staminodes.

The perfect stamens lie at first with their anthers coiled up over the immature pistil, and they ripen slowly, one at a time, each anther as it begins to shed its pollen bending over outward, so as to come into contact with the head and shoulders of the fly who is busily hunting for nectar among the false staminodes. As soon as all the stamens have shed their store, the stigmas of the pistil become fully mature, so that the flies, in visiting the younger flowers, collect pollen on their heads and legs, which they finally rub off upon other blossoms in the second or female stage. This, of course, is a common and familiar device for ensuring the benefits of cross-fertilisation.

It is worth notice that such deceptive flowers occur most especially among the species which lay themselves out to attract the true flies (Diptera). Flies appear to be far more stupid and unintelligent than bees, sand-wasps, moths, and beetles, and therefore more liable to be taken in by simple forms of floral deception. Thus the carrion-flies are imposed upon by many reddish flowers (of which the great oriental *Rafflesia Arnoldi* may be taken as a type)—flowers that imitate putrefying meat in colour and odour, and so induce the flies to lay their eggs upon the surface, and incidentally to cross-fertilise the alluring plants. In the common English arum, again, a very small fly is tempted by the odour to imprison itself behind a *chevaux-de-frise* of hairs; which also happens somewhat differently to another species in the long tube of the south-European birthwort. Müller notes other instances of pure deception in *Ophrys*, *Paris*, *Stapelia*, and a few more flowers, every one of them designed to take in various species of Diptera. There can be very little doubt that this consensus of condemnatory evidence points to an exceptional degree of stupidity on the part of the two-winged order.

On the other hand, the æsthetic taste of the flies is distinctly high. The colours of the flowers which we owe to

the selective action of Diptera are generally pretty; and the grass of Parnassus in particular, which is a creation of the drone-fly group (*Syrphidæ*), is one of the most beautiful and gracefully marked of English flowers. A still more curiously variegated and dappled ally, which also owes its colouration to the selective action of the same family, is the pretty little London Pride of our rockeries and flower gardens. Hardly less delicate is the sky-blue germander speedwell of our hedgerows, yet another production of the lively flies. As in so many other cases, the taste for colour, produced by the search for food among bright blossoms, has re-acted through sexual selection upon the general aspect of the insects themselves; and several of the Syrphidæ are noticeable among all Diptera for the unusual brilliancy and variety of their dainty hues. In fact, wherever in nature we find bright plumage or metallic lustre, we may be almost certain that the creatures which display it feed among crimson and purple flowers, or else among red and yellow tropical fruits.

THE POLYTECHNIC.

By W. Slingo.

WHATEVER pangs one might have experienced when the closing of the old Polytechnic Institution was announced, they cannot fail to be materially blunted when the scope, aim, and influence of the work now being carried on in the building which is occupied by the Polytechnic Young Men's Christian Institute is considered. The great results which have been secured are due in the main to the munificence, combined with the energy and tact, displayed by Mr. Quintin Hogg. Although it is neither in accordance with our rules nor with our purpose to enlarge upon the religious side of the work, it may perhaps be mentioned that considerable efforts are put forth in this direction, howbeit on broad lines. The result must certainly be satisfactory to the founder of the institution, as he has an average attendance at his Sunday afternoon class of no less than 550 persons. It reflects the greatest honour and credit upon Mr. Hogg and his coworkers that their second, if not their first, idea is to foster and promote every feeling, every exercise, every train of thought which is calculated to help a man in his effort to become a good citizen and an honour to his race. That a very large measure of success attends his labours is beyond doubt. The most cursory inspection must convince the most sceptical on this point.

Apart from religious work, the Institute may be divided into three sections, which attend to relaxation, physical exercise, and mental culture respectively.

Upon the first head we need say but little. Reading-rooms, sitting-rooms, "social" rooms, and so forth, are provided on an extensive scale; they are all well patronised, and as the guiding principle is unobtrusive persuasion, or rather enticement, they are likely to remain so. The rooms are open to members of the Institute upon payment of a nominal subscription, which also admits at reduced fees to the classes and other branches of the institution where non-members are admitted. The number of members is, for obvious reasons, limited, the present limit being 3,000, but for a long time past there have been some 1,200 names on the books waiting their turn for admission.

Physical exercise is regarded as one of the necessities of a healthful, happy, and contented life; and accordingly neither expense nor pains are spared to keep this portion of the Institute's work in a state of efficiency. Athletic clubs are formed, and a large and excellently-equipped gymnasium is provided. The gymnasts, it is mentionable, gave a very clever and well-received display at the Healtheries last week. One of the latest additions is a swimming-bath (the tank measuring 76 ft. by 30 ft.) exceedingly well built and artistically decorated. The cost of the bath was £8,000, which amount has been provided by Mr. Hogg, who has also purchased a cricket-field, twenty-seven acres in extent, or three times the size of Lords', at Merton Hall, Wimbledon.

It is, however, to the educational work that attention is here mainly drawn. Classes are formed in an almost endless variety of subjects useful to the masses of our City in the pursuit of their labours. As it is one of the rules of the Institution that at least eighty per cent. of the members shall be *bonâ-fide* mechanics or artisans, it follows, as a natural sequence, that the general tone of the classes should be more or less technical. Amongst the trade classes are two devoted to tailors' cutting, conducted by Dr. Darwin Humphreys, the able editor of "The Record of Fashion," and other well-known works. These classes are eminently successful, and we learn that a certificate of proficiency from the doctor is regarded by the trade as one of the highest and most valuable recommendations. The plumbing class is also an excellent one, the pupils having gained the first three medals in the City and Guilds Institute competition. A class is to be started in the coming session in watch and clock making, under the tuition of Mr. J. Herrman. Every effort is being put forth to make this the most efficient and successful in the kingdom, and there is little doubt but that these efforts will be crowned with success.

The technical classes are very numerous, amongst them being one in Photography, taught by Mr. E. Howard Farmer, whose last year's pupils gained all the seven medals offered by the City and Guilds Institute. Mr. W. Hibbert, F.C.S., a gentleman by no means unknown in scientific circles, is to start a series of classes in Electrical Engineering (telegraphy, electric lighting, and electrical instrument making). A well-equipped laboratory is provided, and there is little doubt but that great things will here be accomplished. Failure, should it result, will not be due either to the institute or its teacher. Boot and Shoemaking is a new subject, to be studied under Mr. A. Hannibal.

The science classes are also very numerous, and the teachers evidently the best in the market, while the apparatus provided is of the highest order. A school of art has been in existence for some time, and is in an admirable state of efficiency. It is noticeable that although the "General" section is very extensive, it only comprises two languages other than English. Those two, however, are the most useful, viz., French and German. It is thought, and, I imagine, wisely, the Latin and Greek are languages very useful and desirable in their way, but altogether beyond the scope of an artisan's requirements. Music has also a large share of attention and patronage. The fees charged are remarkably low, and well within the means of those for whose benefit the classes are intended.

It is worthy of mention that at the City and Guilds Technical Institute examinations, held in May last, the Polytechnic headed the list in the number of successful students, 47 first class and 53 second class certificates being awarded, and, in addition, 14 prize medals, offered in competition to the United Kingdom. In the science examinations, out of 385 candidates who presented themselves for examination, 83 per cent. were successful, being 63 per cent. above the general average. The following prizes, offered in competition to the United Kingdom by the City Company of Coachmakers, were also won by

Polytechnic students, viz. :—First prize, silver medal, and £3, for the best perspective drawing of a Victoria ; second prize, the Company's bronze medal and £2 ; the Company's prize medal for full-sized drawing of a phaëton ; and the Company's certificate and £2 for prize essay on "Carriage Draught."

The total number of individual students enrolled during last winter session amounted to 5,519.

In addition to the many attractions above referred to, a weekly journal, called "Home Tidings," containing sixteen pages of very readable matter, is published, which cannot fail to considerably increase the members' interest in the doings of the Institute.

We have of late heard a good deal about the way things are managed on the Continent, but there does not appear to be anywhere an institution comparable with the Polytechnic, concerning which Mr. Woodall, M.P. (Member of the Royal Commission on Technical Education), stated, at a public meeting held last June, that "he had, in connection with the Royal Commission, visited nearly all the technical training schools on the Continent, and he could safely say he had not seen one in which such a thoroughly practical system was followed as at the Polytechnic Institution."

For my own part, all that I can say is in praise of the Institution and its various departments. Like the School of Submarine Telegraphy in Hanover-square, it is unique, in its own sphere it stands alone, without a peer and almost without a rival. It is earnestly to be hoped that many such may spring up throughout the country, to teach our fellow men that labour is honourable, and, honestly pursued, speedily brings its own reward.

THE INFINITELY GREAT AND THE INFINITELY LITTLE.

By Richard A. Proctor.

AT first there is a sense of relief in turning from the vast-depths of star-strewn space to contemplate the minute, as revealed by the microscope. One may be said to pass from the infinitely great to the infinitely little. Even the domain of the telescope, though really finite, is for us practically infinite ; moreover, the domain of the telescope is obviously but the threshold of a far vaster domain beyond ; every increase of telescopic power has shown more and more stars, more and more of that filmy lustre which indicates the presence of stars beyond telescopic range. In like manner the microscope reveals the infinitely minute, or what is practically such for us ; while manifestly the range of the microscope towards minuteness is but a step towards that ultimate structure which may be regarded as representing absolutely infinite minuteness. Every increase of microscopic power has shown more and more minute details of structure. No astronomer supposes for a moment, now that he has learned so much of the vastness of space, that he can ever know of more than the merest point in extent compared with the infinity which *is* ; no microscopist hopes that he can ever even approach the recognition of the ultimate structure of the objects which come under his scrutiny. We have in fine the same oppression of infinity in studying the minute as in studying the vast.

But this lesson has its parallel when we consider the realms of time, and when we consider the bearing of what we study in our recognition of law throughout the universe. We cannot but perceive that with increase of scale—to consider that point alone, for the moment—comes (on the whole) increase of the duration of the various processes constituting what may be termed life-time. The duration of the animal is far shorter than that of the world, the duration of the world far shorter than that of a system of worlds, the duration of the system of worlds far shorter than that of systems of suns. And as with the duration or totality of life, so is it with the processes belonging to life ; the circulation of an animal's blood, the rotation of a planet, the cycles of planetary revolution, the movements constituting what may be termed the circulation of a galaxy of suns—these various processes extend longer and longer in duration the larger the region of space constituting the domain of that which exhibits them. So, in turning to the minute objects revealed, or in part interpreted by the microscope—so far as we can follow these we see that (speaking, of course, with the broadest generality) the minuter objects have the shorter lives and the most rapid life-processes. While on the one hand we have evidence of material life lasting for periods which to us are practically eternal, we see on the other hand creatures whose whole lives pass before us so quickly that mere instants must be assigned to the undiscernible life-processes belonging to such creatures. Beyond the range of our telescopes on the one hand and of our microscopes on the other, we see "Actual Eternity" and the "Real Instant" as certainly, though we can conceive neither, as we see the infinitely vast and the infinitely minute, which are equally beyond our powers of conception.

But, strangely enough, while all who think at all are ready to admit that the study of the vast and the minute bring before us as realities the mysteries of the infinitely great and of the infinitely small, of infinitely long and infinitely short duration of time, many do not seem to admit, or even to consider it right to admit, the extension of law to the infinitely great or small in extent and in duration. No man now rebukes the astronomer for asserting that the universe is infinitely vaster than that which in former ages men supposed to be the universe, nor is any one troubled (at least, I suppose not) when the microscope reveals millions of millions of tiny objects and minute forms of life of which men in former ages knew nothing, and which in no sense entered into their ideas of creation. So—but perhaps not quite in the same degree—with regard to time : I suppose it may be truly said now that no one with competent power of thinking refuses to recognise the evidence of a practical infinity of time past and to come, during which even that which *is* has existed, or, on the other hand, to admit that in the duration of a single breath lives begin and end of whose very existence men in past times had no idea. But to extend the operation of law to the vast and the minute, in space and in time, is regarded by many as absurd, if not wicked. They cannot seemingly understand that there is nothing more remarkable in the operation of law throughout infinity of time and space, and down to the minutest atoms of matter, than there is in the operation of law on a scale more within our scope. If we admit that a tree grows from the seed, or an animal from the germ, we need not be surprised to find evidence that a world or a system of worlds grows in like manner, or that the tiniest creatures have been developed, even as science recognises that the various kinds of animals and plants have been developed, through multitudinous phases of evolution. At a first view it may seem that in some of the wonders of minute life, the eye of a fly, the tongue of a moth, and so forth, we have objects presenting great difficulties in the way of the general doctrine of evolution. How, it may be asked, could a fly's eye, with all its thousanns of separate facets (or rather eyes) have been developed ? Yet so soon as we consider how it has actually

formed, under the very eyes of science so to speak, we find a mystery quite as overwhelming as the mystery that that very process of formation is itself a development, or the still more impressive mystery that evolution itself, as science deals with it, is a product of a higher process of development.—*Newcastle Weekly Chronicle.*

Editorial Gossip.

If any fresh illustration were needed of the gullibility of the British public, it might well be found in an advertisement which I have met with at once in the columns of the London morning papers, those of the provincial press, and even of, at least, one scientific journal. Here it is, with the address, of course, obliterated :—

> Violin for sale, magnificent solo tone, suit lady or gentleman, labelled Antonius Stradvarus Cremona, 1690, lock-up case and bow, 25s. Sent on approval willingly.

It would, though, be more correct to say *one* of the addresses, as the disinterested possessor of this treasure seemingly changes his (or her) residence every week or ten days, and latterly has even modified the name in the instrument. Need I tell any one who ever heard of the old Masters of Cremona that a *real* Stradvarius violin would instantly be gladly snapped up by Mr. Hart, Mr. Withers, or any other dealer, at a hundred times the sum at which this fiddle is offered. Nay, a genuine "Strad" would find scores of delighted purchasers at £250. There must have been a large number of these things sold, or it would not have paid to repeat the advertisement. Meanwhile the incipient violinist may remember that comparatively few instruments altogether were made by the Amatis, Stradvarius, or Guarnerius, and that, as I have just intimated, were a genuine one by either of these great artists to come into the market, hundreds of pounds (instead of a score or so of shillings) would scarcely buy it.

A reviewer expressed an opinion on p. 243 that astronomers ought to be able to procure Mr. J. E. Gore's capital Catalogue of Variable Stars by purchase. I am glad to learn, from Mr. Gore himself, that it is obtainable at Williams & Norgate's for a very small sum.

Dean Oakley has been denouncing, none too strongly, what has been well described as that "fool's argument," betting. For the tone and temper of those who indulge in this form of gambling is scarcely caricatured in the anecdote of the man who, after offering to take his oath to a certain alleged fact, refused to wager half-a-crown that it was true! Here, though, my purpose is rather to invite attention to the matter in its sociological aspect, and to point out the gross injustice of the law which permits a lad to cripple his patrimony and permanently straiten the circumstances of a widowed mother or orphan sisters with impunity, so long as his bets are made at Tattersall's, or in "the Ring" on any race-course, while his inferior in social rank, who does identically the same thing "in any street, road, highway, or other open and public place" may be convicted and sent to gaol as "a rogue and a vagabond" under 36 and 37 Vict., c. 83, s. 3. And yet we are often gravely assured that there is *not* "one law for the rich and another for the poor."

Here is another contribution to sociological science, in the shape of an advertisement, which, although at first sight it looks like a mere grim joke, may possibly, and even probably, be genuine :—

> A Lady, whose husband has lost his income through mortgages on the estate and agricultural depression, is desired by him to work, as he cannot any longer maintain her; she has endured a very rough and toiling life, and is ready for anything that turns uppermost; excellent health, good sailor and nurse; highest references.—Address, &c.

There are doubtless a few dukes, mine-owners, and manufacturers to whom the *res angusta domi* represents little but a phrase; but the fact remains that the landed classes were never so badly off as they are at this instant, and that the domestic economy of many a stately mansion would very considerably surprise the outside world could they obtain the means of viewing it from within.

Reviews.

SOME BOOKS ON OUR TABLE.

The Mystery of the Universe our Common Faith. By Joseph Wm. Reynolds, M.A. (London : Kegan Paul, Trench, & Co., 1884.)—We think it not impossible that Mr. Reynolds's book may prove convincing—to those who were previously in agreement with its author. That, however, it will carry conviction to the mind, or in any sense alter the opinion of a single reader whose sole end is to examine the question it discusses in an absolutely impartial and judicial spirit, we gravely doubt. It has all the faults of the Duke of Argyll's book, which we reviewed on p. 162 of our last volume, superadded to many others specially pertaining to itself. That its author mistakes assertion for proof is a very euphemistic way of describing the dogmatism which pervades the entire volume. Even had the work been anonymous, it must unhesitatingly have been ascribed to a clergyman, so obviously does it proceed from the pen of a man who is accustomed to make categorical statements in absolute security from interruption or contradiction. *Pulpitem olet.* We disclaim any intention of employing the term in an offensive or discourteous sense, but a more purely *professional* book has seldom come under our notice. The difficulties which beset the earnest student of science in connection with current theology do not arise (as our author over and over again insinuates, even where he does not actually assert) from moral obliquity, or innate wickedness and absolute disinclination to learn the truth; but from a reasonable feeling that evidence, and not assertion, must form the groundwork of our belief. For however strenuously theologians may deny the fact, it remains a fact that belief is *not* voluntary. A man can only really believe a thing as it seems to him. If the salvation of the writer of these lines depended upon his believing that the pen with which they are committed to paper was an oyster, he *must* be damned, no power on earth could save him. We may juggle and quibble with words as we please, but we cannot evade this result of one of the most elementary facts in human psychology. The philosophical doubter of the infallibility of orthodox interpretation requires that his sober arguments shall be met in a similar spirit, and asks for logical demonstration, and not the turgid rhetoric to which he is treated in the work before us. For, sooth to say, it is sermonising throughout. Page after page of bombast, thickly interlarded with poetry (a good deal of it "altered" or "slightly altered") usurps the place of that dialectical treatment for which we are entitled to look in a book like the present one. Its author would seem to have read, and to some extent marked (albeit he has by no means either learned or inwardly digested), several

modern works on science, and he parades scientific terminology in his pages in a way which is well calculated to delude the superficial reader into the belief that he is listening to the utterances of a man who has so far made science his special study as to be familiar with the most recent results of research. How far Mr. Reynolds is entitled to make such a claim, we may gather from the calm way in which he pooh-poohs the conclusions of such intellectual giants as Herbert Spencer, Huxley, Owen, Darwin, Wallace, Romanes, Grant Allen, Lubbock, Geikie, Lewes, Lyell, Tyndall, Lankester, Hæckel, Schmidt, Semper, Wilson, &c., &c., and quotes with approbation from the anonymous author of such washy nonsense as "The New Truth and the Old Faith." Moreover, a spirit of disingenuousness materially impairs the value of, what we suppose we must call, his arguments. In a foot-note on page 150, he speaks, for example, of the perturbations of the planets, &c., as affording exceptions to the rule of uniformity in the solar system, suppressing or ignoring the fact that every one of these perturbations is a direct and immediate result of the same law of gravitation which sustains the planets in their orbits; and that hence such uniformity remains absolutely unbroken. Again, on p. 160, he implies that men of science assert that "man descended from the gorilla," when he knows, or might know, that what is really alleged is not that man descended from the gorilla, but that man and the gorilla had a common ancestor. So, further, with his allegations about "the most eminent scientists," on p. 205. How can he possibly exclude from this category such names as those which we have mentioned above; and dare he, for his purpose, include them in it? His very superficial acquaintance with geology, and especially with palæontology (pp. 233 to 260 *passim*); his chronological quibble on p. 34; and his arrogant charge of "ignorance and presumption" against all who presume to contravene his oracular utterances (p. 379), may be taken almost at random as indications of his fitness for his self-imposed task, and the spirit in which he has approached its performance. "Capable thinkers" (p. 123) are those who agree with him; "lower-class minds" (p. 129), those whom his inflated oratory fails to convince. Such grave difficulties as that presented by the indubitable fact that primæval man was a savage, are never touched upon, nor even hinted at. With that portion of the work having special reference to dogmatic theology we are, perforce, silent here.

A System of Logic. By John Stuart Mill. People's edition. (London: Longmans, Green, & Co., 1884.)—It may seem rather late in the day to notice a book of such world-wide reputation as Mills' "Logic," and we only do so here to note its appearance in a form and at a price which places it within the reach of all. No excuse now exists for unfamiliarity with the *magnum opus* of one of England's greatest thinkers. Those familiar with the earlier editions of Mr. Mill's classical work will find important additions in the present one to the chapter on "Causation" as treated in connection with the modern doctrine of the Conservation of Energy. No educated Englishman can afford to remain ignorant of the conclusions of our great departed philosopher.

We have also on our table *The Poetical Works of Longfellow, Illustrated*, London: Cassell & Co., *Society, The Medical Press and Circular, Our Monthly* (Rangoon), *Naturen, Bradstreet's, The Tricyclist, Ciel et Terre, Technical Education for Millers and Bakers*, by W. Jago, F.C.S., *The Dyer, The Medico-Legal Journal* (New York), *The Railway Review* (Chicago), *The American Druggist*, and an Arabic scientific journal of which, we regret to say, we are wholly unable to decipher either the title or the contents.

TOTAL ECLIPSE OF THE MOON ON OCTOBER 4.

We may add that there will be a Total Eclipse of the Moon during the evening and night of October 4, the Moon remaining totally immersed in the shadow of the Earth for more than an hour and an half.

We append particulars of the times of the various phases of the eclipse:—

	H.	M.		
First contact with penumbra	7	16·8	p.m.	Greenwich Mean Time.
First contact with shadow ...	8	15·2	,,	
Beginning of total phase	9	15·8	,,	
Middle of the eclipse	10	2·0	,,	
End of total phase	10	48·2	,,	
Last contact with shadow ...	11	48·8	,,	
Last contact with penumbra	12	47·2	,,	

Magnitude of the eclipse (Moon's diameter=1), 1·525.

The first contact of the shadow occurs at 83° from the northernmost point of the Moon's limb towards the east.

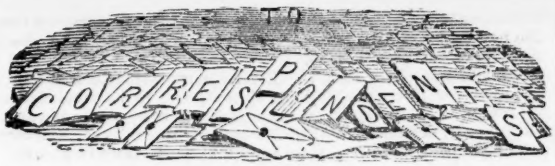
The last contact, 118° towards the west; in each case as viewed with the naked eye.

[The above paragraph was accidentally omitted last week from "The Face of the Sky," on p. 265.]

Miscellanea.

Royal Victoria Hall and Coffee Tavern, Waterloo Bridge-road, S.E.—Attention is called to the fresh series of Popular Science Lectures, which the kindness of various eminent lecturers has enabled the managers of the above hall to arrange on Tuesday evenings, at prices ranging from a penny. On October 7, P. H. Carpenter, Esq., D.Sc., will give a lecture on "Our Bodies, and how they are kept going," and on October 14, J. M. Thomson, Esq., F.R.S.E., Sco. Chem. Soc., will deliver one on "Air and Ventilation," with experiments. These lectures will all be illustrated with dissolving views, and followed by popular glees, solos, &c., by the Royal Victoria Choir and Band. The concert season at the above hall is now definitely announced to begin on Thursday, October 2nd. The first and second Thursday evenings are to be under the efficient charge of Mr. Lenthal Swifte, and for several succeeding concerts arrangements are being made with such well-known artists as Messrs. F. N. Bridge, George Cox, Mesdames Evans, Warwick, and Annette Frances, Mr. Sinclair Dunn, and many others of like position whose names will shortly be published. Much care is devoted to the arrangement of the programmes so as to secure all possible brightness and variety, and no exertion will be spared to make the season a brilliant and successful one.

The Colours of Tropical Man.—In a recent issue of a contemporary an attempt has been made by Surgeon-Major Alcock to explain the apparently anomalous condition of a dark skin being best adapted for a hot climate. The basis of the argument is that for every permanent characteristic in the animal kingdom there is a special use, therefore blackness of skin must subserve some purpose. The two agents to which the body of an unclothed man is most exposed are clearly heat and light. In a hot climate the action of the former would be obviously intensified by falling on a dark surface; this increased activity must be compensated for by some beneficial effect with regard to light. In support of this the immense influence of the light-waves of the sun upon the great vegetable worlds, past and present, is referred to, and it is asserted that their power upon the animal body has been lost sight of owing to their transcendent results upon the nerve of the eye, which is itself but an exalted nerve of the skin, and which, though it now can see, could once but feel. It is then pointed out that the response of a nerve to a stimulus, consists in increased vibration of the molecular elements of which the nerve is composed; in fact, that when the vibratory waves of heat or light impinge upon nerves attuned to vibrate at the same pitch (as when a piano string takes up a note sung at it), these nerves receive the motion thus communicated, and it is thus that light and radiant heat are absorbed. If, then, in addition to the motion unavoidably set up in the sentient extremities of the nerve-endings by the heat-waves, there should be the further motion which the light-waves are also capable of inducing, the double stimulus would give rise to an amount of molecular disturbance which would be injurious to the species. To prevent this, the light-waves are blocked at the surface by the interposition of pigment. In fact, "the black skin of the negro is but the smoked glass through which alone his wide-spread sentient nerve-endings could be enabled to regard the sun."



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

DR. LARDNER AND TRANSATLANTIC NAVIGATION.

[1419]—May I be permitted to point out that the late Dr. Lardner gave an emphatic denial to the statement (which I have before heard, and which he takes pains to rebut as a popular error), *i.e.*, that he asserted Atlantic steam navigation to be impossible. He says that at the British Association Meeting in 1836, he advocated one of the projects. At p. 118, Vol. X., of the *Museum of Science and Art*, appears an extract from the *Times* of 1837, showing his ideas on the subject, which were simply that too much should not be immediately expected, and that caution should be used. I do not know if he ever held a different opinion, but if not, I consider it only fair to his memory to notice these facts. He adds:—"What I did affirm and maintain in 1836-7 was, that the long sea voyages by steam which were contemplated, could not at that time be maintained with that regularity and certainty which are indispensable to commercial success, by any revenue which could be expected from traffic alone, and that, without a Government subsidy of a considerable amount, such lines of steamers, although they might be started, could not be permanently maintained." He then goes on to notice what was the actual subsequent fate of the earliest Atlantic steamers, which quite corroborates what he had advanced. He likewise mentions that, "long antecedent to the epoch now adverted to, the Atlantic had actually been crossed by the steamers *Savannah* and *Curaçoa*."

SIMPLEX.

ORTHOGRAPHIC MAPS.

[1420]—In an oblique orthographic map of a hemisphere, if you cross the ellipse that represents the equator, by an equal and similar one, turned the contrary way, this ellipse will pass through the foci of all the traces of meridians, and afford a wonderfully ready way of both finding their ends and striking them all with one trammel. I should like to see this demonstrated. E. L. G.

THE WICKED FLEA.

[1421]—"The Wicked Flea" and all other insects hate creosote' which I find is more effective than Keating's Powder.

JOHN ALEX. OLLARD.

AN INVALID ON THE COVENTRY CHAIR.

[1422]—If Mr. Browning could put himself in the place of an invalid, I don't think he would talk of the "Coventy chair" superseding the present Bath chair. He would know that "a crawling pace of about two miles an hour" is more suitable to the nerves of an invalid than the tearing pace of a tricycle. Besides, the "Coventry chair" would be excluded from the parade and the pier—favourite resorts of invalids at seaside places—and would have to keep in the road, where the fear of collision with horse-vehicles is very distressing to an invalid who cannot stir from his place, whatever happens. If he wishes to go only in the roads and streets, he had better go for a drive in an ordinary carriage, which, being of a larger size than a Bath chair or tricycle, can hold its own against other vehicles. I speak feelingly, for, even in this quiet place, I am always in a state of trepidation till my chair reaches the parade. E. C. H.

Worthing.

SOLUTION OF FIGURE PUZZLE (1398).

[1423]—Let x be the number. Writing the figures in order B C D E F A is equivalent to multiplying x by 10, adding A and subtracting 10^6 A.

$$\therefore \quad 10x + A - 10^6 A = 3x.$$

$$\therefore \quad 7x = (10^6 - 1)\,A \qquad \therefore \quad A = \frac{7x}{999999}$$

Similarly,

$$30x + B - 10^6 B = 2x \qquad \therefore \quad B = \frac{28x}{999999}$$

$$C = \frac{14x}{999999} \qquad D = \frac{56x}{999999} \qquad E = \frac{35x}{999999}$$

But $F + 10\,E + 10^2\,D + 10^3\,C + 10^4\,B + 10^5\,A = x$

$$\therefore \quad F + \frac{999950}{999999}x = x$$

$$\therefore \quad F = \frac{49}{999999}x = \frac{7x}{142857}$$

Now F must be an integer less than 10, and 7 is prime to 142857 $\therefore$ x must = 142857.

$\therefore$ 142857 is the number required. KIT.

[1424]—About a fortnight ago a friend sent me the puzzle given by E. Sidders in letter 1398. It appeared, I think, in the *Liverpool Courier*.

I recognised it as a curious property of the number formed by the recurring decimal representing the vulgar fraction $\frac{1}{7}$.

$$\frac{1}{7} = \dot{1}\,4\,2\,8\,5\,\dot{7}$$

	A B C D E F	
A B C D E F	= 1 4 2 8 5 7	= the number
B C D E F A	= 4 2 8 5 7 1	= 3 times the number
C D E F A B	= 2 8 5 7 1 4	= twice ,,
D E F A B C	= 8 5 7 1 4 2	= 6 times ,,
E F A B C D	= 5 7 1 4 2 8	= 4 times ,,
F A B C D E	= 7 1 4 2 8 5	= 5 times ,,

R. B.

[Correct solutions, mainly, it would seem, by the system of trial and error, have also been received from E. C. H., H. K., C. J. B., F. B. Whitmore, F. G. S., P. P. G. Goolden, E. O. H., G. H. Howe, J. McD., T. K. H., and others.—ED.]

COINCIDENCES.

[1425]—Seeing in your issue of July 25th last a letter headed "A Coincidence," it has struck me that an experience of mine in the same direction may amuse some of your readers.

One night several years ago I went to a dance in town. I dressed at a well-known hotel, only going there just before the dance, gave no name, left my luggage, on which there was no name, and returned to sleep about 3 o'clock. Next morning, on coming down, a porter addressed me *by name*, and handed me a card. It bore the printed name of a man whom I only knew by name. Over the name was written in pencil my name, initials all correct, and on the back, also in pencil, a direction to an address curiously like mine (the number identical, and one being Old Square and the other Old Jewry), and in a very similar handwriting to that of, and signed with the initials of, a man whose whereabouts I did not know, and whom I was anxious to see. I asked the porter how he knew it was for me; he said it had been left while I was out for a gentleman who was expected that night, and I was the only one who had come.

Now, I never was in that hotel before or since. I only made up my mind to go ten minutes before I went. The card was meant for some one else, who bore (as I found out by a directory) my exact name in initials and only with a small variation in full. That person was expected there that night and did not come. The card belonged to a man of whose existence I knew. The writing on the back resembled that of, and the initials were the same as those of a man whom I wanted to see, but who was then in India (as I found out later), and the address given was curiously like mine. And yet my connection with the whole thing was a pure accident. A document so going astray in a play or novel would be set down as an improbability; but this was what did happen in the case of this card. I may add that none of the names were common ones, and one is a particularly uncommon one. It seems to me to be a nest of "coincidences." EXSUL.

[1426]—A few years since, I was waiting for a train to arrive at the station of a large town, that I might go on by it. I saw an elderly gentleman, whose face struck me and who looked hard at me. We soon recognised each other, though we had not met for forty-two years. After talking for some time of old days, the train

came in, and we were then standing at the door of a compartment which I intended to enter, and in which were two or three ladies, one seated close to the door. I then said, "What became of that beauty, Miss ——, who married —— ——?" naming a very pretty but fast young lady. Instead of answering me, he walked quietly away, and, on my joining him, said, "That was her in the carriage close to you, and she must have heard you."

I had heard of her marriage soon after I left England, more than forty-one years before, and, about four years after, I heard of her husband's death. From that time I had not heard of her, neither did I know if she was living.

Does not this strange coincidence prove that "truth is stranger than fiction?" S.

Morai, Aug. 22.

[1427]—Apropos to the numerous coincidences reported in your columns, I send you a true story, which, however, hardly comes under the term coincidence. At Darjeeling, early in 1864, a few of us banded together and formed a club, the main object of which, barring social intercourse, was to play upon an ancient and chronically-frozen wooden billiard-table. As the Derby drew on it was proposed that we should have a lottery, and settle matters finally on a future day. As I cared not an atom for racing, I had no intention of joining; but, strange to say, that night, and the one following, I had the same dream or revelation most vividly impressed upon me—"Join the lottery, and you will draw Cambuscan." I thought this so strange that I mentioned it to my friends in the club, stated my determination to join the lottery, and my fixed expectation of drawing Cambuscan. Of course, my vaticination was greeted with credulity or derision, and more so when the drawing-day came, and I declared my determination to draw last, in full confidence that my ticket would bear Cambuscan. So it was; each drew, and one paper remained in the hat, which I took, and it bore the name "Cambuscan." "I'll give you R300 for your ticket," cried a member. "No, thank you, I expect the whole lottery," I greedily answered. But Cambuscan did not win the Derby, but ran second. R. F. H.

GIVING UP THE GHOST.

[1428]—Mr. Lodge in his ghost story [1379], recorded in a recent issue of your useful publication, states that in America General Winyard beheld at the *same* hour as his brother died in England, a "figure" that "bore the strongest resemblance" to him.

Allowing for the difference of time, if Mr. Lodge's story be "A Fact," as stated, the ghost must have appeared in America at least more than four hours before the General's brother died in England.

Did the General's brother know *beforehand* the *precise hour* he should die? Could his ghost (supposing he had one) have crossed the Atlantic several hours before his death?

Can ghosts at *one stride* cross over thousands of miles? Can they from *afar* discern the one they seek and *instantaneously* appear to him? If so, who would not be "a ghost?" C. R.

THE BEAN-FLOWER.

[1429]—I shall be glad if Mr. Grant Allen can inform me what insect it is which pierces a hole through the calyx of the bean-flower on its upper side and close to the junction with the receptacle. I thought at first it might be bees; so watched, and saw several bees visit flowers, but in *all* cases they rejected those which were unpierced, and sucked the honey through this hole. What insect frequents the bean-flower, and so fertilises it? I have always been *told* that bees are very fond of this flower, but, for my own part, I have never found them visit the bean except as above stated. E. W.

PHONETIC SPELLING.

[1430]—I am much obliged to you for going so far in the direction of qualifying your previous opposition to the improvement of spelling. May I say that it would have been most unreasonable on my part had I urged the adoption, or even the partial introduction, of improved spelling in your journal. Its discussion, however, is another matter. The study of phonetics is unquestionably a branch of the great domain of science, and as such would, I suppose, come within the scope of your publication. Even the practical questions of the early invention of alphabetical writing on phonetic principles by a gradual evolution from a hieroglyphical system, the improvements naturally necessitated by its transference to fresh languages, and the degradation and restoration of the forms and values of the letters, would also appear to merit consideration. Whether the double invention (1) of a sufficiently complete alphabet for the representation of our speech by separate signs for each well-marked sound, and (2) the devising of a graduated series of successive intermediate modes of spelling so as to carry us over the inevitable transition state—whether these are beneath notice I must leave you to determine.

I would not claim that the Reform must grumble if crowded out, nor yet if opposed by fair debate; but to be treated with contempt, based merely upon misapprehension, by one so impartial as yourself, demands an effort to remove the misunderstanding, which you will, doubtless, approve. J. Greevz Fisher.

PHOSPHORESCENCE OF THE SEA.

[1431]—On Sunday, Sept. 2, during a passage from Hull to Antwerp, I witnessed a brilliant display of the above phenomenon. On the day mentioned we were in the midst of a severe cyclonic storm, and as night closed in, the waves, which were of considerable proportions, became luminous to a remarkable degree. So bright were these lights that our pilot, knowing that we were near the coast, but being unable to detect the Dutch lights from amongst so many, and afraid of venturing nearer, anchored until daybreak. Are such brilliant displays of rare occurrence in the North Sea? Am I correct in thinking that the luminosity in question was caused by myriads of Noctiluca miliaris? A. Pearson.

TRANSPORT OF PUMICE-STONE BY OCEAN CURRENTS.

[1432]—Here, at a missionary station, whither news does not arrive with much speed or regularity, I have just read in your issue of April 18, an article on "The Spread of the Krakatoa Dust-Cloud," which gives the astonishing rate of 1,700 miles a day for the conveyance of light dust in the air from east to west. I am able to supply an analogous fact with regard to the rate of the associated pumice-stone, probably from the same eruption, through the water. Late in June, I was at Zanzibar, when the western coast was suddenly observed to be lined at high-water mark with great quantities of this substance, of all sizes up to that of a child's head, extending for at least four miles south of Zanzibar, and I think I heard of it twenty miles north. Hearing Java suggested as the source of the phenomenon, I made a rough calculation of the intervening time and distance by ocean current, which appeared to give a rate of about twenty miles a day, or less than a mile an hour—a rate almost as surprising for its slowness as that of the aërial dust for its rapidity, but I suppose by no means inconsistent with it. I crossed the channel to the mainland a few days ago, and expected to find a similar lining along this coast at Payani, which is about 1° N. of Zanzibar (*i.e.*, 5° S. of Equator); but I only found a single small specimen.

In February last, I noticed green halos round the moon, which was itself similarly tinted. Yours faithfully

A. H. Hamilton.

Mkuzi, East Africa, July 24, 1884.

IS COLOUR OBJECTIVE?

[1433]—The contention in my letters was not for a change of common parlance, but of scientific language; nor do I see how you can consistently object to that, as you have by your own admission found it necessary to impress the non-externality of colour on the readers of Knowledge. My contention was, that the erroneous conception of the externality of colour has led to endless mistakes in attempts to expound the theory of the harmony of colour, and notably on that special point of the so-called *primaries* and *secondaries*.

The belief in the externality of colour has led artists and writers to imagine that the student has to study some outer objective harmony, some relations of the prismatic spectrum, instead of the laws of his own sentient nature. It has also led to the phenomena of the accidental colours of the ocular spectra being treated even in professedly scientific works as external realities when they have no externality whatever, and to many other mistakes too numerous to mention. It is from the æsthetic point of view that the nomenclature of the text-books on colour are so misleading. Men who are accustomed to abstract reasoning do not require the fact, on which I have laid so much stress, to be repeatedly pressed home to them, but with the artist it is a different matter. Even quite recently I met with a painter lecturing on colour, who was as confident of its externality as of that of the canvas and frame of his picture.

But to resume my argument in respect to *primaries* and *secondaries*, it must be clear that we cannot treat the sensations themselves—those which we name red, green, and violet—as *primaries*. It must be something in the nature of the wave-lengths, which cause those sensations, that would give them the right to this distinction. But Brewster affirms that no single wave

of the prismatic spectrum can be decomposed; every wave in this series is therefore of an equally indecomposable rank; but he also states that in some instances similar sensations of colour can be produced, by compounding two waves, to those produced by single waves in other positions of that spectrum, but that, in these cases, the two original waves may be resolved by the prism, showing thereby that there is no such thing as a secondary vibration in the natural series of wave-differentiations. W. Cave Thomas.

SLAUGHTERING ANIMALS.

[1434]—If you will allow me to add to your remarks anent the use of the poleaxe as an effective means towards "Euthanasia for the Lower Creation," I would say that the method of poleaxing admits of modification so as to be easily applied in the case of the smaller animals, as sheep, pigs, &c., when being slaughtered. If a piece of steel rod or wire—not larger than a ¼ inch diameter—be fixed at right angles to a short handle of wood, we have an instrument which, if placed over the proper point of the animal's cranium, and struck with a short heavy stick, will deprive the animal of sensibility as quickly and as surely as the poleaxe does in the case of oxen. Norfolk Farmer.

MIND AND BRAIN.

[1435]—If the Rev. S. F. B. Perrin will read the first volume of "The Mechanism of Man," by the late Mr. Serjeant Cox (Longmans, 2 vols.), he will find, I believe, an answer more or less satisfactory to the question he raises in his letter, No. 1404.

To embody in a letter the contents of nearly five hundred pages is impossible, but it may suffice to say that the dominant idea of the writer is that three forces direct the mechanism of man—namely, *Life*, mortal, beginning and ending with earthly existence. *Mind*, the aggregate action of all the intellectual and emotional powers of the brain. *Soul*, the self, the *ego*, the conscious I, the man, unlike the body, unchangeable, imperishable; the brain and the nerves being the material medium through which the soul receives by the senses communications from external nature, and by the will transmits its mandates to the body, and manifests itself to the outward world.

M. Louis Figuier, in his "Day after Death," considers that man consists of three elements. The body, the life, and the soul, but he deals with the future of the last, rather than with the question under consideration. Eye-Witness.

LIFE AFTER DEATH.

[1436]—Seated one afternoon a few weeks ago in a room overlooking an arm of the sea, I witnessed a scene the incidents of which re-aroused in my mind certain thoughts concerning the hereafter, which for years had slumbered.

Half a mile or so out when it first caught my eye, was a punt with one occupant. He was pulling easily shorewards, and shortly drew up close to the steps leading on to the pier. There was a strong tide running, and the water was very deep. The oarsman, evidently a novice, clumsily endeavoured to bring his punt into a position to enable him to leap ashore, and when, as he thought, sufficiently near, he jumped, but fell backwards into the water. There were a number of people about, who endeavoured to assist the drowning man; but as the boat had drifted away with the tide, their efforts were unavailing, and he sank for the last time. Just after, a man arrived from a short distance with a boat-hook, and, quite at random, not knowing where the body had sunk, groped about in the water. By an almost miraculous chance, he succeeded in catching a portion of the submerged man's clothing, and so hauled him to land, and after a time, by the application of suitable means, life was restored.

I interviewed the victim some days after, and elicited the fact that practically he had been dead. He had suffered all that he could suffer from the drowning process, and had become totally oblivious of any sensation whatever. His body was so much drowned as to have stopped thought and destroyed consciousness. He knew and felt *nothing whatever*, and lay at the bottom of the water, to all intents and purposes stone dead.

Now, sir, if there is, as some teach, a life after death, why was no sign of it manifested here? Those who teach the doctrine of a hereafter, aver that death does not destroy the mind. If this be true, why was this man unconscious of everything? He recked not of this world or the next. It is, of course, impossible to ask those who die and do *not* return to life, whether, during the passage from this life to the life supposed to be hereafter, a state of absolute oblivion intervened, and how long it continued. But in the case I have just related, the man was practically killed, his body was bereft of breath and motion, and this physical state produced a total suspension of his mental and physical faculties, a state of things which, *so long as he continued dead, manifested no symptom of change whatever*; no throb of another life animated his mind or his soul, and the probability is, that if he had continued unhelped, and remained under water till his body had been decomposed utterly or eaten by fish, no change or reawakening in his mental or spiritual faculties would have occurred, but that he would have remained as he was, dead—body, soul, and spirit—for ever.

I do not, sir, with all deference, think I am, by introducing this subject, trenching on the limits you have wisely indicated with regard to theological questions. Theology I have long since and utterly discarded and put aside, as far as I am personally concerned. I only present the subject as an effort to obtain knowledge, and I do hope to hear from some of your extremely able correspondents on the matter. I take a deep interest in the question of a future life. I do not believe there is such a thing, but, on the other hand, I do not *know*. I often feel as if, like the two disciples of an ancient philosopher who heard of immortality for the first time, and immediately and violently "shuffled off this mortal coil," I would like to put an end to a somewhat troublesome existence from mere curiosity, and so solve, for myself at least, the great riddle. But there is no need for this. I think the question may be settled otherwise.—I am, Selwyn Thorne.

[The very curious and momentous question raised in Mr. Thorne's letter must be discussed in these columns from a purely scientific point of view alone. We have had more than enough of the *odium theologicum* lately. A few (fortunately a very few) readers never see anything here conflicting with *their* particular form of orthodoxy without writing letters—which, of course, I never print—not obscurely hinting that I am an infidel and an atheist for permitting anything to appear that runs counter to the views of that most straitest sect to which they may happen to belong. Whatever such writers may think, it is both hurtful and offensive to me to be branded in such untruthful fashion. Hence my determination that while science shall not interfere in Knowledge with dogmatic theology, neither shall dogmatic theology interfere with science.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

[Owing to some muddle among various post-offices, one packet of redirected letters has gone entirely astray. Perhaps correspondents whose communications are neither noticed here, nor appear in our correspondence columns within three weeks, will kindly write again.]

A. H. R.E., T., Ed. Walker, Alfred Buss, Thos. Ward, Robert Moore, H. Huber, A. G. H. S., M. Smith, H. Minchin, Jessie H. Howat, Chas. J. Wetherill, Pi, G. J. Pilcher, E. W. Gundry, B. Gleam, and a large number of other correspondents, send solutions, some mathematical and some empirical, of Mr. Sidder's figure puzzle.—Daniel Dewar. Received.—Nigel Doble. In making observations it is customary to attach a number to each, expressive of its accuracy or trustworthiness; 10 representing a *perfect* observation and 1 a worthless, or practically worthless, one. Such a number is technically known as the "weight" of the observation to which it is appended.—Ignoramus. See "Mars in a Three-inch Telescope," vol. V., p. 140.—W. J. Harding. The notice (which you will find elsewhere this week) was omitted from "The Face of the Sky" last week by an error. No directions for finding the new comet can be given until its elements are computed, and an ephemeris calculated from them. It is, I fancy, in Cygnus.—John W. Staniforth points out that Encke's Comet was seen on Aug. 20, 1881, by Dr. Hartwig and Prof. Winnecke at Strasburg; on the 24th by O. Struve at Pulkowa; and on the 28th by Lohse at Dunecht. In September it was observed on the 20th at Nashville, Tennessee, and five days later by our own correspondent, "F.R.A.S." Many thanks for the information.—T. Hartley. Delayed for several days, owing to your addressing your letter to "the Editor." It is the *Publishers* who supply copies of Knowledge.—W. Franklin. I regret that I can afford no space in these columns for the discussion or exposure of that exploded imposture spiritualism.—B. Gleam. "Five of Clubs" is on the other side of the Atlantic. Can any whist-playing reader give the name of the publishers of the "Westminster Papers," and say if the back numbers are now procurable?—H. L. I have never even heard of the system you speak of. Pitman's leaves nothing to be desired.—A. Steele. Doubtless the act of the cat was prompted by the conviction that it had done wrong. Its progenitors had been punished for acts of theft, and it seems more than probable that what we call "instinct" is merely inherited memory. In this sense each successive generation of domesticated animals may improve in morality.—Ignoramus. No wonder the M.R.C.S. laughed at such an assertion. That editor and you might pair off as you suggest.—A Geologist. The facts, certainly not the *inferences*. The "publicity" of which you speak was doubtless a mistake.

Our Chess Column.

By Mephisto.

THE GAMBIT DECLINED.

(*Continued from p. 228.*)

THE easiest way of declining the Gambit is by playing 1. P to K4, P to K4. 2. P to KB4, B to B4. Of course White cannot play 3. P × P, on account of Q to R5 (ch). A similar bad result would follow 3. B to B4, for then Black would play B × Kt. 4. R × B, Q to R5 (ch). 5. K to B sq., Q × P (ch), &c. Positions, however, often occur in this Opening and the Vienna Game when the check on R5 is disadvantageous for Black. Thus, for instance, if White plays 3. QKt to B3, it would not be good to play as before, *i.e.*, 1. P to K4, P to K4. 2. P to KB4, B to B4. 3. QKt to B3, B × Kt. 4. R × B, Q to R5 (ch). 5. P to Kt3, Q × RP. 6. R to Kt2. Now the Q dare not play to R sq., as she would there be sadly out of play, if Q to R6, White can play 7. P × P with a strong centre and an open game, or he may first play 7. Kt to Q5, followed by P × P and Kt to B4.

The Q is often lost in this variation. It follows that discrimination is required before (ch) on R5 is given in this Opening. It is mostly good if Black has the chance of doing so after the White KB has moved.

In reply to 3. Kt to QB3, Black plays :—

Black.

White.

3.		P to Q3.
4.	Kt to B3	Kt to KB3
5.	B to B4 (*a*)	P to B3
6.	P to Q3 (threatening P to Q4)	Q to K2
7.	Q to K2	B to Kt5
8.	B to K3	Kt to Q2
9.	Castles QR	Castles QR

and the position is fairly even.

(*a*) White would jeopardise his position if 5. P × P, P × P. 6. Kt × P, Q to Q5. 7. Kt to Q3, B to Kt3. Although a P ahead, White has a very bad position 8. Q to B3, B to KKt5, followed by Castles with a strong attack.

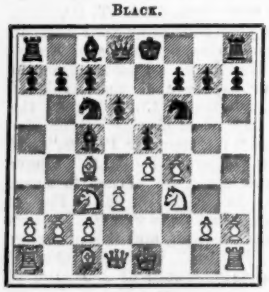
Instead of P to B3 Black may on his 5th move play Kt to B3 in the main variation, when the following might result, 5. Kt to B3. 6. P to Q3. We have now a main position which occurs in another variation of the Gambit Declined, when White plays 3. Kt to KB3, and which is also brought about by a transposition of moves in the Vienna game, *i.e.* :—

1. P to K4	P to K4, or	1. P to K4	P to K4
2. P to KB4	B to B4	2. Kt to QB3	B to B4
3. *Kt to KB3*	P to Q3	3. P to B4	P to Q3
4. B to B4	Kt to KB3	4. Kt to B3	Kt to QB3
5. P to Q3	Kt to QB3	5. B to B4	Kt to B3
6. Kt to QB3		6. P to Q3	

It is therefore of more importance to know the main features of an Opening, than merely to commit certain lines of play to memory. A player who understands the principle of each opening (which we endeavour to show) will, if he plays with judgment, mostly find the right way of steering clear of danger, though the attacking moves be varied.

Now we are certain that in this position many a game has been lost by Black playing Kt to Kt5, or that White (if he be a careful player) in order to avoid the position, crippled his game unnecessarily, for in reality Kt to Kt5 by proper defence will result in improving White's game, *i.e.* :—

Black.



White.

6.		Kt to KKt5
7.	Q to K2	B to B7 (ch)
8.	K to B sq.	B to Kt3
9.	P to KR3	Kt to B3
10.	P to B5	Kt to KR4
11.	Q to K sq.	

to be followed by P to KKt4, and White's game will be well-developed. Instead of 6. Kt to Kt5 Black may Castle without much danger or play B to KKt5. White may adopt another line of play, *i.e.*, 1. P to K, P to K4. 2. P to KB4, B to B4. 3. Kt to KB3, P to Q3. 4. *P to B3.* To this, Black would reply with B to KKt5. 5. B to B4, Kt to QB3. 6. P to Kt4, B to Kt3. 7. P to QR4, P to QR3, with a fair defence.

With a slight transposition of the moves, we give the variation of the game recently published in our columns between Zukertort and Judd. 1. P to K4, P to K4. 2. P to KB4, B to B4. 3. Kt to QB3, P to Q3. 4. Kt to B3, Kt to KB3. 5. B to B4, Castles. 6. P to Q3, P to B3. 7. Q to K2, P to QKt4. 8. B to Kt3. Here we should play QKt to Q2, or Q to K2, with the intention of then proceeding with P to QR4, B to R3, and R to K sq., &c.

PROBLEM No. 129.

Having last week amended the position by placing a Black P on KKt4, we defer the solution till next week.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. W. Smith.—Pray excuse us if we did not succeed in making ourselves intelligible—apparently an exceedingly difficult task. In the position of the consultation game, *second diagram, p.* 188, *after White's* 32*nd move*, the Black Q cannot play to Kt6. The whole point of the position consists in the fact that the Black Q must protect the KBP, as otherwise mate in four follows, *i.e.*, 32. Q to Kt6. 33. B to R7 (ch), K to R sq. 34. B to Kt6 (ch), K to Kt sq. 35. Q to R7 (ch), K to B sq. 36. Q × P mate; *vide* also analysis, p. 208.

E. W. Y.—You are quite right. In the game Zukertort *v.* Judd, p. 248, White would have done better to play 14. B × Kt, and if then K × B, 15. Q to B3 (ch), followed by 16. Kt to K2.

R. F. (Dundee.)—Received with thanks. It is a well-known press rule that persons not wishing their name to appear, must affix some other signature to their contributions.

W. Furnival.—Problem welcome, and will be examined. Solution of 129 correct.

F. J. D.—Thanks for your kind promise.

S. B. C.—In Problem No. 129, if 1. Kt to K4 (ch), K to Kt3. 2. B to Kt4, Kt to Kt2, and you cannot mate in two moves, for if 3. Q to QB8, R to Kt sq. In Problem 130 you have likewise not struck oil, for if 1. Q to Kt2, R to Q7. 2. Q × B (ch), other R interposes, and there is no mate.

Wm. De Morgan.—See above reply.

Correct Solutions received.—Problem No. 126, Chas. Wilbraham. No. 127, W. Parker. No. 129, M. T. Hooton. No. 130, W., William Godden, F. J. D.

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